· ENGINEERING NEWS-RECORD ·
AUGUST 25, 1938

THE WEEK'S EVENTS

PWA Sets Quotas For States

Agency will not make grants on projects contingent on November bond votes

Although no official announcement has been made, PWA officials have revealed that action is being slowed up on applications for allotments from a number of states that have already received a disproportionate share of the money voted by Congress for the present program. With sufficient applications in sight to exhaust the fund, this step has been taken to ensure an equitable distribution of the benefits of the pump-priming program.

It is known that nine states have received their full allotment of public works funds. This was revealed in a letter written by President Roosevelt to Senator Harrison in connection with an application of the State of Mississippi for a large grant for highway construction. PWA officials, however, decline to reveal the names of the nine states.

Basis of quotas

Quotas for states are based upon population and the amount of unemployment, the President's letter reveals. If some of the states do not submit applications within a reasonable time for their proportion of the fund the money will be reallocated among the states that are ready to go ahead with projects at once.

Details of the plan have not been made public. It is known, however, that a tentative and somewhat flexible maximum quota has been set for each state. As this figure is approached, additional projects receive increasingly careful scrutiny, with preference being given to relatively small applications as against those involving large amounts.

Mississippi's experience

Mississippi submitted an application for a grant of $26,646,385 to apply on a state-wide highway project to cost $59,215,189. The project was approved by the technical divisions, but the President pointed out in his letter that Mississippi's quota is $9,940,000. Allotments already made to the state total $7,264,277. This leaves $2,676,223 to be allotted before the quota is reached. If that amount is allotted exclusively to highways pending applications for such projects as schools, sewers and streets will have to be abandoned.

PWA has also announced that it will not promise allocations for projects the prosecution of which depends upon November bond elections. Such applications are on file to the aggregate amount of about $35,000,000. It is felt that it is not fair to earmark funds for projects which may be turned down by an adverse vote while applications are available for projects that are not subject to this risk.

Wide World, ENR Staff

THOUSAND ISLANDS BRIDGE IS DEDICATED

THE THOUSAND ISLANDS BRIDGE connection between Ivy Lea, Ont., and Collins Landing, N. Y., was dedicated August 18 in the presence of both President Roosevelt and Prime Minister King of Canada.

As pointed out on page 231 of this issue, the Thousand Islands Bridge, actually a 7-mile highway, incorporates five different bridges, two suspension spans, a steel arch, a continuous truss, and a rigid frame concrete span shown above. The latter, 90 ft. long, crosses the international boundary line. It was at this bridge that the major part of the ceremony took place.

Contracts Let Locally On Housing Jobs

Fixed price contracts required and sectional bidding is recommended by USHA

Full responsibility for initiating and letting of contracts on USHA-financed housing projects rests on the local housing authority handling the project, according to a statement issued Aug. 16 by Nathan Straus, administrator of the U. S. Housing Authority. Contractors on jobs in the $8,000,000,000 low-rent housing program now going forward will be responsible only to the local authority he said.

Although USHA retains a certain degree of supervision over local authorities, this will not extend beyond the limits needed to assure compliance with the U. S. Housing Act and the loan contract under which USHA loans 90 per cent of the total development cost of the project to the local housing authority. "At no time," said Straus, "should this supervision lead to additional costs which might be reflected in higher bids by contractors."

A USHA construction advisor has been appointed by Administrator Straus, to act in an advisory capacity to the local authorities. But the adviser is specifically prohibited from giving orders to a contractor. And although USHA will review plans and specifications, responsibility for the design and for meeting loan contract requirements is left with the local authority.

Fixed price contract

Under the policy of the USHA all work will be performed on a fixed price contract basis. In addition, USHA recommends that local housing authorities divide their projects into several sections, permitting small contractors to bid on parts of the work.

A form of contract has been recommended for use by local authorities. It is based on the standard form of contract approved by the American Institute of Architects, with only such modifications as are required to conform to federal and state statutes and the policies of the USHA.

Completion time

A reasonable time will be provided under the contracts in which to complete the work. USHA has recommended that bidders be given an opportunity to specify, within a limited range, a shorter time in which they may elect to complete the contract. In evaluating bids, consideration would be given to any shorter time that might be specified by the bidder, and the bid price would be reduced, for the purpose of evaluating his bid by a stated amount for each day less than the time specified in the contract proposal.

In general, successful bidders will be required to furnish a payment and performance bond amounting to 50 per cent of the contract price.

Payment to contractor

The approved method of paying contractors contemplates that partial payments will be made as the work progresses, payment for each calendar month being made not later than the 15th of the next month. Payment will be made on estimates certified to by the architect and signed by the local authority, such estimates being submitted at least ten days in advance of the payment date.

In making these partial payments, the local authority will retain ten per cent of the estimated amount until final completion and acceptance of all the work. If, however, after 50 per cent of the work has been completed, the architect certifies that satisfactory progress is being made, the remaining payments will be made in full.

Payment will be made on certification of the architect or local authority, without any necessity of obtaining the approval of such payment by USHA.

Under sponsorship of USHA and the Building Trades Department of the American Federation of Labor, agreements are being reached between local housing authorities and local building trades councils throughout the country, aimed at preventing a stoppage of operations because of labor disputes. Agreements have already been signed with 70 buildings trades councils and 184 local unions. These agreements provide that jurisdictional disputes will not lead to a stoppage of work until the building trades department of the AFL, the local authority, and USHA have had an opportunity to adjust the differences. It is also provided that wage rates in effect at the time that work starts on any contract unit of a low-renting housing project remain in effect until completion of the project.

• • •

Investigation Voted On Niagara Plant

Because of "considerable public comment" on the delay in completing the Niagara Falls sewage disposal plant, the city council of Niagara Falls, N. Y., on August 15, directed the city manager to prepare and present to the council, a "full and complete statement of the present status of the sewage disposal plant, what steps are being taken to bring about an early completion, and the approximate date when completion thereof is expected."

Housing Amendment Adopted in New York

Constitutional convention at Albany approves a state financed housing program

An amendment to the New York state constitution providing machinery for a state housing program independent of the federal program, was adopted Aug. 18 by the New York state constitutional convention. Just before its passage it received three important amendments, two of which were bitterly opposed by the sponsors of the measure.

Approval of the constitutional amendment by the convention means that it will be submitted to the voters in November and if approved will be incorporated in the state constitution.

The housing measure authorizes the state legislature to issue up to $300,000,000 in bonds for low cost housing construction. The proceeds of the bonds would be loaned to local governments.

In addition, municipalities are authorized to borrow funds amounting to two per cent of the community's assessed valuation outside of the municipal debt limit. Money borrowed from the new state housing fund is included in the two per cent limitation. The measure would help to finance housing projects by giving power of excess condemnation to both the state and municipalities, thus enabling the communities to profit by the rise in property values around a housing project.

The new state program includes provisions for annual subsidies to reduce the rental on public housing projects. As finally passed, it authorizes the legislature to increase the total annual subsidy paid out by $1,000,000 each year to a maximum of $5,000,000 annually.

The change in the measure to which proponents objected most was the introduction of a provision that municipalities borrowing funds for low cost housing must provide special taxes to meet the charges on such debts. The debt would still be secured by the full credit of the community, but taxes on real estate could only be invoked if the special taxes proved insufficient to carry the charges.

A second change altered an authorization for communities to engage in low rent housing to authorize only low rent dwelling houses. Housing advocates attacked this change as making impractical the erection and renting of shops and provision of nurseries in housing projects.

Sponsors of the measure themselves presented an amendment requiring that loans and grants for housing be made only on projects conforming to a plan for slum clearance on rehabilitation.

Hydro Program Planned In Wisconsin

Private companies cooperate with Wisconsin Development Corporation in obtaining licenses

The Federal Power Commission on Aug. 19 announced that it had received applications for licenses to construct a number of hydroelectric and storage projects in Wisconsin with a total power capacity of about 75,000 kw. These projects, according to the commission, are parts of a comprehensive plan of water storage, flood control and power development proposed on the Wisconsin, Little Eau Pleine, and Fox rivers.

Although the commission did not so state, it is understood that the plan referred to is that prepared by the Wisconsin Development Corp., a state agency. The corporation early this month applied for a PWA grant of $26,000,000 to aid in carrying out a program believed to consist essentially of the projects now before the Federal Power Commission. It is understood that if the grant goes through, the three private power companies negotiating with the power commission will turn over their licenses to the Wisconsin Hydro Authority, a state body to be organized under the auspices of the Wisconsin Development Corp.

The three power companies involved are the Consolidated Water Power & Paper Co., Consolidated Water Power Co., a wholly owned subsidiary, and Mosinee Paper Mills Co.

Details of plan

Major item in the program is the $5,715,000 Germantown works on the dam and power house. The new dam will be about 1,550 ft. long and create a maximum head of about 28 ft. Equipment will consist of four 5,450-hp. hydroelectric units. Power would be carried to the lines of the Wisconsin Power & Light Co. and the Milwaukee Electric Light & R. Co.

The Pentenwell works, also on the Wisconsin River, near Necedah, would consist of a 1,500-ft. long concrete dam, creating a 42-ft. head, and a power house with a peak load capacity of 40,000 kw. Power from this plant also would go to Wisconsin Power & Light and Milwaukee Electric Light & Railway. This project is estimated to cost $9,138,000.

Also contemplated is a storage reservoir on the Little Eau Pleine, a tributary of the Wisconsin. This would be a compacted earthfill dam about 8,000 ft. long, and costing $2,500,000. This project would also involve a bypass canal costing $1,175,000, and a 30-ft. diameter tunnel about 1,900 ft. long and costing $981,000.

A canal in the vicinity of Portage will connect the Wisconsin and upper Fox rivers to divert 1,500 sec.ft. during the dry months of the summer. This canal will cost $535,000.

All the above projects are to be built by Consolidated Water Power & Paper. In addition, Consolidated Water Power is asking permission to build a hydroelectric project on the Wisconsin River at Knowlton. This would be a concrete dam, about 600 ft. long and creating a head of 27 ft. Equipment would consist of three hydroelectric units of 4,130 hp. each. Power would be turned into the lines of either the Wisconsin Public Service Corp. or Consolidated Water Power.

Mosinee Paper Mills is asking a license for a concrete dam on the Wisconsin at Mosinee, replacing an existing dam near Wausau. The new dam will be about 750 ft. long and is primarily intended to increase the storage capacity of the proposed reservoir on the Little Eau Pleine. It is estimated to cost $249,330.

• • •

Rader Gets Award For Highway Paper

Lloyd F. Rader, associate professor of civil engineering at the Polytechnic Institute of Brooklyn, has been awarded the Prize of Belgium in a world-wide competition, sponsored by the Permanent International Association of Road Congresses which met last June. The prize, established by the government of Belgium about ten years ago, is an award of 2,000 francs for the dissertation contributing most to the advancement of highway engineering. The first award of the prize was made in 1930 to Edwin W. James of the U.S. Bureau of Public Roads.

Rader's paper was "Investigation of the Physical Properties of Asphalt Paving Mixtures at Low Temperature."

• • •

Illinois Guards Against Diversion Penalty

The Illinois state legislature at its recent special session, voted to divert $2,500,000 of gasoline tax revenue for relief in Chicago. In order to guard against the possibility that its federal aid payments might be cut as a penalty for this diversion, the legislature added a requirement that Chicago restore to the state highway fund any amount the Bureau of Public Roads withholds from the state.

Airport Money To Continue

New administrative system not expected to reduce federal aid to airport building

Washington Correspondence

Aviation enthusiasts confidently predict that the federal government's present annual expenditure of approximately $30,000,000 for the construction and improvement of civil airports will continue at an undiminished—perhaps even augmented—rate under the centralized control of aviation recently approved by Congress.

So far, the bulk of this money has come from relief funds through grants administered by the airport section of the Works Progress Administration, a group hitherto affiliated with the Bureau of Air Commerce but now to be taken over by the new Civil Aeronautics Authority. The latter has statutory authority not only to continue the national survey of airports (due for completion February 1, 1939) but also to approve the expenditure of federal funds on civil airports. Indications are that the airport section will enjoy even more prestige under the new arrangement than it had before.

So far the earmarking of relief funds for airports has worked out well for two reasons: the normal type of relief labor available matches up with the tasks to be performed, and the money could be obtained without the need of a definite appropriation. But sooner or later a Congressional battle must be fought on the issue.

• • •

Dumping Case Dismissed In Brooklyn Court

Brooklyn Supreme Court has dismissed a taxpayer's suit which sought an injunction to restrain the city of New York from carrying out a plan of the department of sanitation to dump refuse in Jamaica Bay. (*ENR*, Aug. 4, 1938, p. 127). The suit also sought to restrain the city from purchasing 30 steel scows for hauling refuse.

On the dumping question, the court held that the petition had failed to show illegality, waste or injury to property in the plan. There was nothing in the complaint, it was held, to indicate that it was either apparent or inevitable that the proposed plan would result in a nuisance. No cause of action was presented in the case of the dump scows because the city showed that they were needed for dumping ashes in the ocean and for "other permitted and unobjectionable uses".

Otto Tittmann Dies Was C. & G. S. Head

McKibben of Foundation Company dies—Dakin was Boston sewer engineer

Otto H. Tittmann, former superintendent of the U. S. Coast & Geodetic Survey died Aug. 21 in Leesburg, Va. at the age of 81. Tittmann retired from the survey in 1915.

Educated in the public schools of St. Louis, Tittmann entered the U.S. Coast Survey in 1867 as an aide. He rose to the rank of assistant astronomer, did survey work on the east and west coasts and in 1889 was placed in charge of weights and measures. In 1895, Tittmann was made assistant superintendent of the survey and in that same year he was American delegate to the International Geodetic Conference in Berlin. Four years later he became superintendent of the survey, holding that position until his retirement in 1915. During this period, he represented this country in settling the Alaska-Canada boundary. For four years after his retirement, Tittmann was president of the National Geographic Society.

William T. McKibben, who retired several years ago from a position as general superintendent of the Underpinning and Foundation Co. of New York City, died there Aug. 21. McKibben was in charge of construction work for the foundation company on several sections of subway in Manhattan and Brooklyn and had also worked on the Catskill Aqueduct.

George W. Dakin, who retired this month as division engineer of the Boston Sewer Department, died August 16 there at the age of 63. Dakin joined the city service immediately upon his graduation from Massachusetts Institute of Technology in 1896 and had served the city in various capacities since that time.

Robert A. Davis, 53, Birmingham building contractor, died there Aug. 13.

Alfred T. Trudel, a civil engineer with the Canadian Department of Public Works, died recently in Ottawa. Trudel was for many years an engineer for the Transcontinental Ry.

Ralph Johnson, 58, former president of the Jackson Contracting Co., died Aug. 18 at Niagara Falls, N. Y. Johnson had recently been employed as an engineer in the Niagara Falls city engineer's office.

Bids Asked for September On Tacoma Bridge

The Washington State Toll Bridge Authority has asked for bids on construction of a $5,400,000 suspension bridge across the Narrows in Puget Sound near Tacoma. Bids will be opened Sept. 2 in Olympia.

The authority has obtained a PWA grant of $2,700,000 for construction of the project. An application for a loan of $3,300,000 is still pending, but, in order to protect its grant, the authority has obtained permission from PWA to call for bids, which will be cancelled if the project fails to go through.

The proposed bridge will be 5,550 ft. long overall, with a 2,600-ft. suspension span and side spans of 1,300 ft. It will carry a 26-ft. roadway.

• • •

Austin Co. Organizes British Firm

The Austin Co., Cleveland engineering and building firm which has built industrial and commercial structures throughout this country and Canada as well as in Europe, Africa, and Asia, announced plans, August 19, to establish its own construction organization in England. The new firm, known as Austin Engineers Builders, Ltd., will be under the managing directorship of Allan S. Austin.

Decision to establish the British subsidiary followed a survey by Albert S. Low, vice-president and chief engineer of the company, which indicated the probability of extensive industrial construction throughout Great Britain.

Managing Director A. S. Austin is the grandson of Samuel Austin, founder of the firm. A graduate of Sheffield Scientific School of Yale University, he has been associated with the company since 1927. In 1930 he had an active part in construction of the $40,000,000 Gorki automobile works for the Soviet government. He was elected director of the company two years ago.

The new London organization will be the first complete permanent staff established by Austin outside of the United States and Canada.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

American Public Works Association, annual meeting, New York City, Oct. 3-5.

National Safety Council, annual congress, Stevens Hotel, Chicago, Oct. 10-14.

American Institute of Steel Construction, annual convention, French Lick Springs, Ind., Oct. 10-13.

Montana National Bituminous Congress, Edgewater Gulf Hotel, Biloxi, Miss., Oct. 10-13.

National Reclamation Association, annual meeting, Reno, Nev., Oct. 11-13.

American Society of Civil Engineers, fall meeting, Rochester, N. Y., Oct. 12-14.

American Welding Society annual meeting, Book-Cadillac Hotel, Detroit, October 16-21.

National Society of Professional Engineers, annual meeting, Pittsburgh October 17-18

American Railway Bridge and Building Association, annual meeting, Hotel Stephens, Chicago, October 18-20.

Canadian Institute of Sewage and Sanitation, annual convention, Royal York Hotel, Toronto, October 20-21.

American Public Health Association, annual meeting, Kansas City, October 25-28.

LOCAL AND REGIONAL

American Water Works Association, local section meetings scheduled:
Rocky Mountain, Casper, Sept. 12-13.
New York, Poughkeepsie, Sept. 22-23.
Wisconsin, in Milwaukee, Oct. 10-12.
Four States, Washington, October 6-7.
South West, Oklahoma City, Oct. 17-20.
New Jersey, Asbury Park, Oct. 21-22.

California Sewage Works Association, joint meeting with California League of Municipalities, Santa Barbara, September 6-7.

Society for the Promotion of Engineering Education, Regional Conference on Surveying and Mapping, University of Louisville, Louisville, Ky., Sept. 5-8.

Western Safety Conference, annual meeting, Los Angeles, Sept. 12-15.

New England Water Works Association, annual convention, Hotel Statler, Boston, Sept. 13-16.

Rocky Mountain Sewage Works Association, annual meeting, Casper, Wyo., Sept. 14.

New England Sewage Works Association, and New York Sewage Works Association, joint meeting, Hotel Bond, Hartford, Oct. 6-8.

Michigan Association of Road Commissioners and Engineers, Michigan State College, East Lansing, Oct. 25-27.

Bids Are Received On D.C. Parking Meters

Twelve bids from seven manufacturers were opened Aug. 16 by officials of the District of Columbia, covering the purchase of enough parking meters to serve the peripheries of four city blocks, as authorized by Congress for a one-year trial period. Bids ranged from a low of $28.25 each, submitted by the Park Rite Corp., Houston, Tex., to a high of $65.00. Second low bid was $29.30, by the Michaels Art Bronze Co.

All bidders offered the semi-automatic type of meters except one, the Graybar Electric Co., which offered the semi-automatic type at $42.50 and a fully automatic meter at $52.50.

The machines will be tested for compliance with specifications before the contract is awarded.

CONTRACTS AND CAPITAL

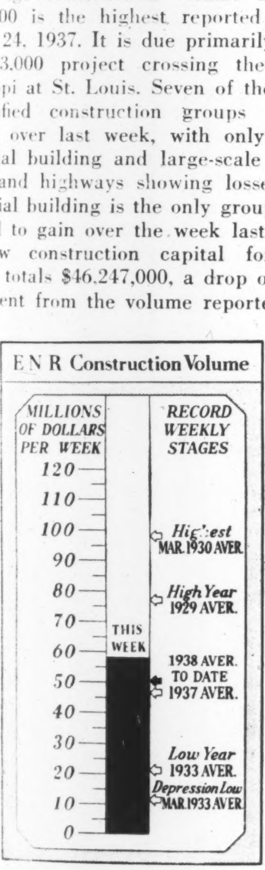
Engineering construction awards for the week, $57,907,000, are 30 per cent above last week, and 55 per cent above the corresponding week in 1937.

This week's volume brings the 1938 total to $1,714,535,000, an increase of 2.3 per cent over the $1,675,497,000 reported for the 34-week period in 1937.

Public construction is 31 per cent above a week ago, and 134 per cent above the 1937 week. These gains are due to the large federal projects getting under way. Private construction tops last week by 28 per cent, but drops 39 per cent below the 1937 week.

Bridge construction volume at $6,659,000 is the highest reported since June 24, 1937. It is due primarily to a $5,383,000 project crossing the Mississippi at St. Louis. Seven of the nine classified construction groups report gains over last week, with only commercial building and large-scale housing, and highways showing losses. Industrial building is the only group that failed to gain over the week last year.

New construction capital for the week totals $46,247,000, a drop of 36.5 per cent from the volume reported for the corresponding 1937 week. This week's total is made up of $20,604,000 in PWA allotments for non-federal projects, $13,410,000 in state and municipal bonds, and $12,233,000 in corporate security issues.



CONTRACTS

(Thousands of dollars)

	Week Ending Aug. 26 1937	Week Ending Aug. 18 1938	Week Ending Aug. 25 1938
Federal	$3,510	$7,607	$17,861
State & Municipal	16,752	28,755	29,672
Total public....	$20,262	$36,362	$47,533
Total private..	17,076	8,117	10,374
TOTALS	$37,338	$44,479	$57,907

Cumulative

1938 .... (34 weeks) ..$1,714,535

1937 .. (34 weeks)....$1,675,497

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1937 34 Wk.	Cumulative 1938 34 Wk.
NON-FEDERAL	$1,064,926	$1,594,917
State & Mun. bonds	374,486	382,355
Corporate securities	393,602	268,192
PWA loans, grants.	66,899	479,822
RFC loans	29,939	96,891
U.S.H.A. loans ..	......	154,528
R.E.A. loans	......	11,629
Federal Aid-Highways	200,000	201,500
FEDERAL	$261,057	$1,143,942
TOTAL CAPITAL	$1,325,983	$2,738,859

FHA MORTGAGES

	Cumulative 1937 33 Wk.	Cumulative 1938 33 Wk.
Mortg. selected for appraisal	$417,563	$616,422

ENR INDEX NUMBERS

Index Base		1913	1926
Construction Cost	Aug..	232.39	111.71
Building Cost	Aug..	194.49	105.14
Volume	July....	207	91

Detroit Firms Act On PWA Complaints

Plumbing and heating contractors dissolve trade agreement association

Plumbing and heating contractors of Detroit have decided to dissolve the Voluntary Trade Agreement Association and to end their practice of bidding through the association. This action follows a complaint by the PWA that free competition in the submission of bids was being suppressed, "through the medium of bid depositories operating with the aid of certain labor unions". (*ENR*, Aug. 4, 1938, p. 125). PWA Administrator Ickes last month called the attention of Mayor Reading to the situation. In response to Ickes' letter, the prosecuting attorney of Wayne County took up the question with the administrative committee of the Voluntary Trade Agreement Association as a result of which it disbanded and discontinued the practice of bidding through the association.

• • •

District Awarded Damages On Broadway Tunnel

U.S. District Court at San Francisco has awarded damages of $309,000 to the Joint Highway District No. 13 against Six Companies of California, Inc. The damages cover losses incurred by the district when Six Companies abandoned its contract to construct the Broadway low-level tunnel at Oakland.

The same court recently rejected a claim by the contractor for damages to compensate it for losses it claimed to have incurred before abandoning the contract (*ENR*, July 7, 1938, p. 4).

• • •

Industrial Buildings Studied at N. Y. U.

An innovation in college engineering instruction is the offering for the fall evening term at New York University of a graduate course in "Advanced Industrial Building Design." The course will focus attention on such new developments as rigid girder and truss bents, roof arches, continuous bents on flexible supports, elimination of wall columns, the adaptation of tee columns, the use of large glazed areas, of welding and of new types of surface coverings.

Another new evening graduate course to be presented at the same time will cover "Advanced Reinforced Concrete." The two courses will be under the supervision of Professors Harold E Wessman and William A. Rose.

Road Department Signs With Engineers Union

Minnesota highway department signs contract recognizing FAECT as bargaining agent

Chapter 30 of the Federation of Architects, Engineers, Chemists and Technicians, C.I.O., was recognized as the bargaining agency for all its members employed by the Minnesota highway department in a contract signed by Commissioner of Highways Elsberg, Aug. 4. The executive committee of the union has recommended to the membership that they ratify the contract at the next meeting of the chapter, Aug. 29.

Existing salary rates are incorporated in the contract, except that a provision is made that any employee not at the top rate of his classification receive an increase of $5 each six months until he reaches the top rate.

Classifications are specified in the contract as being those in the regular classification book, except that a revised classification is set up for the engineering department. Hours also are to remain as at present, but a slightly higher rate than straight time is provided for overtime work.

Seniority

The contract provides that seniority lists of all employees be prepared, any employee who has served a total of twelve months being entitled to seniority. Necessary reductions in forces are to be made by seniority, and employees who are laid off must be re-employed when positions are available according to their seniority.

Promotions are to be made from among qualified employees, qualification to be determined by the commissioner of highways. A list of employees entitled to promotion is to be prepared, and any employee has the right to be placed on the list unless reasons are given him why he is not entitled to promotion.

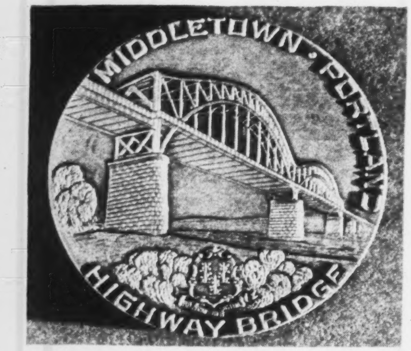
Provision is included in the contract for establishment of an arbitration board to settle disputes between the union and the department.

• • •

Our Apologies!

Readers who may have been puzzled, horrified, or disturbed by the cryptic caption on the cartoon in last week's news pages, will be relieved to learn that the sketch is part of the publicity material issued by the 23rd U.S. Engineers in connection with their forthcoming reunion. The 23rd is the highway regiment of the A.E.F., recruited from the state highway department with the assistance of this journal.

Omitted by the printer were paragraphs which would have explained that the cartoon represented a few suggestions from the reunion committee as to means by which former members of the 23rd Engineers might get to the regimental get-together at Los Angeles, Sept. 17-22. Held at the same time as the American Legion convention, the reunion will have headquarters at Cabrillo Hotel. C. H. Jeffries, 2416-16th St., Los Angeles, is chairman of the reunion committee.



ANOTHER BRIDGE MEDAL

As PART of the ceremony in connection with the opening of the new bridge over the Connecticut River at Middletown, Conn., the Middletown-Portland Highway Bridge Committee had struck off a bronze medallion, 3 in. in diameter, showing on the obverse the main spans of the bridge and on the reverse a map of Connecticut indicating the importance of the bridge to intercommunication within the state. Also struck off was a smaller replica of the design as a pocket piece. Engineers who make a hobby of collecting medals of bridges can obtain copies from the committee at Middletown; the large one sells for $2.75 and the small one for 25 cents.

• • •

Two Buildings Fail In Washington

Two different buildings suffered structural failure within 24 hours of each other in Washington, D. C., last week. Two upper floors of a 4-story structure occupied by the Columbia Specialty Box Factory collapsed Aug. 12. One person was hurt in the accident. It is believed that overloading of the two upper floors caused failure of several wooden floor-beams.

On the next day, the rear of a two-story building caved in, due, it is believed, to weakening of the foundations during the construction of a rear basement.

Cement Company Starts Pension Plan

In order to meet the needs of its employees earning more than $3,000 per year, the Marquette Cement Mfg. Co. of Chicago has adopted a private pension plan supplementing the federal social security benefits. The federal plan provides benefits on income up to $3,000 per year.

The Marquette program contemplates that employees earning $3,000 or more will make payments, in addition to social security deductions, ranging from $7.20 per month on an income of $3,000 to $60 per month on an income of $16,200. These payments will be supplemented by the company in order to provide a pension at retirement age. Based on an income of $3,000, this pension would be $3 per month multiplied by the number of years for which the employee has been a contributor to the plan. The amount of this base benefit increases a dollar for each increase of $600 in the income on which contributions are computed.

• • •

I.C.C. Absolves Railroad Of Blame for Wreck

The Interstate Commerce Commission on Aug. 20 held that the Chicago, Milwaukee, St. Paul & Pacific R.R. was not guilty of any negligence in connection with the wreck of a crack train near Saugus, Mont., June 19, in which 47 people were killed (*ENR* June 23, 1938, p. 859). The disaster, I.C.C. found, "was caused by the undermining of the piers of a bridge, due to a cloudburst."

Bridge and tracks had adequate safety margins and were well maintained, according to the commission. All testimony indicated that the train was proceeding at less than the permissible speed. The sudden increase in the depth of the water in Custer Creek, from 2 or 3 ft. to more than 20 ft., was more than the bridge could resist.

• • •

Typhoid Deaths in 1937 Hit New Low

Typhoid deaths in American cities during 1937 were at a record low figure of 0.76 per 100,000 population, according to an annual survey made by the *Journal* of the American Medical Association. This continues the steady decline in typhoid deaths which has been in progress since 1910, when the rate in principal American cities was 20.54 per 100,000 population. The A.M.A. survey covers 78 cities with a total population of about 37,000,000.

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Aren't We All

Sir: I wonder if you could give me some information. I would like to know where the longest-time-to-build construction job is that would employ a plumber or steamfitter on it and closest to Phoenix, Arizona. After two years of in-and-out work I want to find a job that will last awhile.

Elwood L. Cassel
1111 No. Adams St., Phoenix, Arizona

Professional Activities

Sir: Your comment of Aug. 4 (p. 134) on the entrance of A.S.C.E. into the field of professional economics merits a prominent position on all engineering bulletin boards.

In 1934, this "foundering" society, because of its "large membership," was appointed by the NRA to represent the profession in drafting a code of fair competition for the construction industry. The society proceeded to parry charges that engineers would thus be subject to the standard $0.40 per hour basic pay scale, by stating that the policy of the NRA did not permit more than a single minimum wage be specified for all codes, and that engineers would not be included in that classification. Let us look into the musty records.

In other chapters of the various codes, special scales were provided for electricians, plasterers, plumbers, tinsmiths, and even plaster's laborers. Then, in answer to an inquiry by an architect regarding the status of his employees, the approved construction code was interpreted as classifying engineers in the ranks of common labor without benefit of a specified maximum number of hours per week!

I cite these facts as a prelude to more pertinent observations. In 1934, the various state societies of professional engineers were advised that the lack of an integrated organization prevented them from representing the profession and that their individual schedules must be presented to the A.S.C.E. for consideration. This action was ignored by A.S.C.E. Then was formed the confederation of state societies known as the National Society of Professional Engineers. Composed only of legally recognized engineers, it formulated certain objectives, e.g.: advancement of licensure, engineering recognition, promotion of public works, curtailment of student enrollment, better standards of compensation. Its four year record stands examination.

Now the A.S.C.E. board of direction sets up "a new committee on professional objectives as an *alternative* to a division on professional activities as was called for in a petition sent to the Board in January 1937." I note that the listed objectives conform to the program of N.S.P.E., and that action on the petition from the membership occurred twenty months after receipt.

I smell mice and plagiarism.

G. Edmund Geyer
Consulting Engineer
Philadelphia, Pa., Aug. 18, 1938

Clean Slate for Hastings

Sir: Mr. C. J. Velz, in his interesting article, "A Picture of Pollution In the Hudson," (*ENR*, Aug. 11, 1938, p. 181) has listed Hastings as having no sewage treatment facilities.

The Village of Hastings on Hudson is entirely served by the Saw Mill Valley and North Yonkers Valley trunk sewers of the Westchester County Sanitary Sewer Commission system, both of which discharge through the North Yonkers disposal plant.

John C. White
Village Engineer
Aug. 12, 1938
Hastings on Hudson, N. Y.

With Rod and Gun?

Sir: In the Aug. 4 issue, p. 133, a letter from Mr. Terrill Isbell, Jacksboro, Tex., states: "Will you ask some good surveyor to come down and draw this tract on the map for us?"

I would appreciate it if in the future you would refer such requests to me, as I have made surveys from no better description than the one which puzzles Mr. Isbell. Take this for an example: "Part of the Isiah Adams tract in New Jersey. The property of the Fairy Lake Corp. at Moriah, Essex County, N. Y."

Such jobs usually take from one week to one month to accomplish and would cost $10 per day plus traveling expenses. Difficult jobs are my specialty.

John B. Burt
Architect
15 Park Row, New York

Everyday Concrete

Sir: I do not like the term "Everyday Concrete", used in the editorial in the July 14, 1938 issue. Why not use the same phrase to apply to all materials and lose, as has concrete, that quality of expressing the good in it rather than its weaknesses?

Familiarity with cement and concrete has bred carelessness in its use. We see the same mix ratio used for four or five purposes on a job, and the only regulation is the addition to or the subtraction from the mass a given amount of water so as to provide different degrees of workability.

Since cement-concrete is a chemical operation and should be so considered at all times, the more conscious the user becomes of this quality the better concrete will be secured, because the maker of the concrete will begin to recognize that if he controls the water many of his troubles will be eased. But both he and the concrete technician should recognize that the only substitute they have for water reduction is labor. Low-water content concrete is harder to place.

Recently on a job, I had occasion to question the amount of water in the concrete. I was told it was 5½ gals. per bag of cement. We had a check run on the sand and gravel and found it was 7.2 gallons per bag, and that the water total was based on a previous run. In the meantime, the source of sand changed and the moisture in the sand increased from 4 to 9.8 per cent.

It is such a simple matter to check these items, that to the writer's mind, there is no job too small but what it is entitled to the best of supervision.

Chas. L. Kirk
Vice-President
Eddystone Portland Puzzolan Cement Co.
Pittsburgh, Pa., August 19, 1938

ENGINEERING NEWS-RECORD
Copyright 1938, by McGraw-Hill Publishing Company, Inc.
Volume 121, Number 8

Editor, F. E. SCHMITT • *Editorial Staff,* V. T. BOUGHTON
C. S. HILL, N. A. BOWERS, W. G. BOWMAN, E. J. CLEARY
W. W. DE BERARD, H. W. RICHARDSON, R. B. COLBORN
Editorial Offices at 330 West 42nd Street, New York

AUGUST 25, 1938

FEW HAZARDS encountered in the range of the civil engineer's experience can match that of a loose-rock tunnel face many feet below water. When a compressed-air tunnel enters such a face gradually the skill and vigilance of the miner are taxed to the utmost in maintaining thorough seal and dependable support on every square inch of the exposed surface while dislodging piece after piece of its material to push the tunnel ahead. Every foot of advance means a fight. But still greater was the hazard in winning back the lost face of the Queens Midtown tunnel, where air-blowing and water-washing had cleared out the interstices between the stones and opened free passage for water and air over nearly the whole area of the 31-ft. face. In regaining the heading after the fire that led to flooding of the tunnel some weeks ago the working crews accomplished a rare performance, one of which everyone concerned may feel proud. The Queens tunnel is not yet through with its difficulties, but the courage and skill displayed in winning the lost heading give assurance of success.

Rio Grande Development

BY SYSTEMATIC IRRIGATION development the Mexican government for a number of years has been modernizing its land and agriculture under a broad, farseeing plan. The dam at Azucar now being built on the San Juan river supplements the storage works on the upper tributaries of the Rio Grande and increases the country's facilities for building up large scale agricultural production along the United States border. This development should increase the republic's wealth substantially and at the same time reduce losses from flood destruction. But while Mexico will gain from its storage and irrigation enterprise, lands to the north of the Rio Grande are likely to lose, since the river's flow will be diminished and the irrigation pumping plants in the United States will have less water to draw on. The time is thus brought nearer when the river's total supply will have to be conserved and apportioned. International storage on the main river has repeatedly been recommended as the best means of conservation, though even with such storage it may be found that irrigation on the north bank has been expanded beyond the limits of supply. Construction of Azucar Dam brings nearer the day when river storage works must be built.

Nuisance Not Inherent

JUDICIAL DENIAL of an injunction requested to forbid New York City's making refuse fills embodies much horse sense. In effect the judge said that complaint against refuse filling is not warranted until the practice creates an actual nuisance, and that there is no certainty in advance that it will do so. This view of the case checks with experience showing that refuse filling can be done in inoffensive manner and that nuisance is not inherent in the practice but when it occurs is chargeable to faulty method or to neglect. As a matter of fact New York City has been carrying on nuisance-free, land-fill operations for at least a year and it is continuing to refine and improve its methods. The days of the noisome Rikers Island dump, well-remembered along the upper East River, are fortunately over: they are not a measure of proper and careful refuse-fill practice. Land disposal of garbage and rubbish is entitled to fair appraisal on the basis of its economy and other points of utility; it should not be condemned until actual nuisance is proved, and in such event the condemnation may more properly be directed against the methods used than against the system itself.

Unsound Financing

NEW CONSTRUCTION for electric utilities in recent years has been financed chiefly from earnings, cash reserves or the proceeds of bonds, according to a survey made recently. Less than 20 per cent of the work has been financed by the sale of stock. No ill effects have resulted from this practice because the demand for new facilities has not been large and most electric utilities are conservatively financed. Yet continuation of the practice or its extension to meet growing demands would be undesirable and might lead to a condition such as the railroads have been in for the past decade or more. Bonds with their fixed interest charges make up so large a part of the railroads' capital structure that many roads have not been able to keep in a solvent condition. Using earnings to finance new construction cuts dividends and in turn depresses the market value of stocks, thus creating the vicious circle in which it becomes necessary to sell more and more bonds to get needed capital. This is a situation that needs to be recognized and avoided. The quickest way to head it off is to end the uncertainty created by the government's ineffective efforts to regulate the utilities by competition.

Theory and Test

STRESS ANALYSIS of structures is not an exact process, for all its apparent precision and its dependence on complex formulas. Where confirmation of theory by experience is inadequate or lacking, thorough verification by test offers a desirable and often quite indispensable assurance. It is the increasing recognition of this fact that has led to the extending use of test methods, both model and full size, as confirmation of design assumptions and analyses.

Present trends are strongly in the direction of continued extension of such test verification. Every major structure of recent years has been found to involve incertainties beyond the reach of existing data or analytical procedure, and tests of either exploration or confirmation have come to be an accepted part of modern design and construction programs. Witness the special test work done in connection with bridges such as those over the Delaware, the Hudson and San Francisco Bay, or the elaborate investigations connected with Boulder Dam and its compeers; or, again, the extensive research work after construction that is represented by hundreds of stress and strain gages buried in recently built dams and now under periodic observation. Or we might cite the Mississippi River cutoff and channel regulation program, guided both before construction and after completion by measurements on models and on the river itself.

It is a fact also that extension of analytical ingenuity has not kept pace with the growing scale of engineering operations. One reason among others is the impossibility of transferring the conventional procedures of applied mechanics from small, homogeneous and uncracked pieces of material to large bodies full of heterogeneities and breaks. For the time being at least these conditions will continue to limit the practicable refinements of mathematical analysis of structures and increase the importance of test measurements before or after construction.

The relative fields of model test and full-size test in serving this important requirement still await full appraisal. Practice, however, is progressively revealing the limitations of both methods. Uncertainties are inherent in model tests because of the impossibility of reproducing to small scale the physical makeup of the full-sized work—most notable perhaps in hydraulic model work such as investigations of channel formation and beach changes. On the other hand the full-sized test has corresponding shortcomings. A large bridge member is apt to contain stress irregularities that are difficult to evaluate; the strains in a dam are disturbed by local conditions which may make any one measurement valueless; full-sized channel effects may be the result of indetectable local influences rather than of a law applying to the channel as a whole.

Test procedure will undoubtedly see much further development before it is efficiently adapted to the work of guiding and verifying the design of structures. Present experiences tend to show that investigation of full-sized structures will yield the most valuable information, especially as it progresses further in measuring stresses and other basic values rather than in merely supplying proof-test information. The practice of the last ten or fifteen years amply supports this conclusion, and it appears safe to say that if the desirable custom of coupling up essential investigations with the construction of every major project is continued we may expect more progress in civil engineering during the next quarter century than many generations of theory alone could produce.

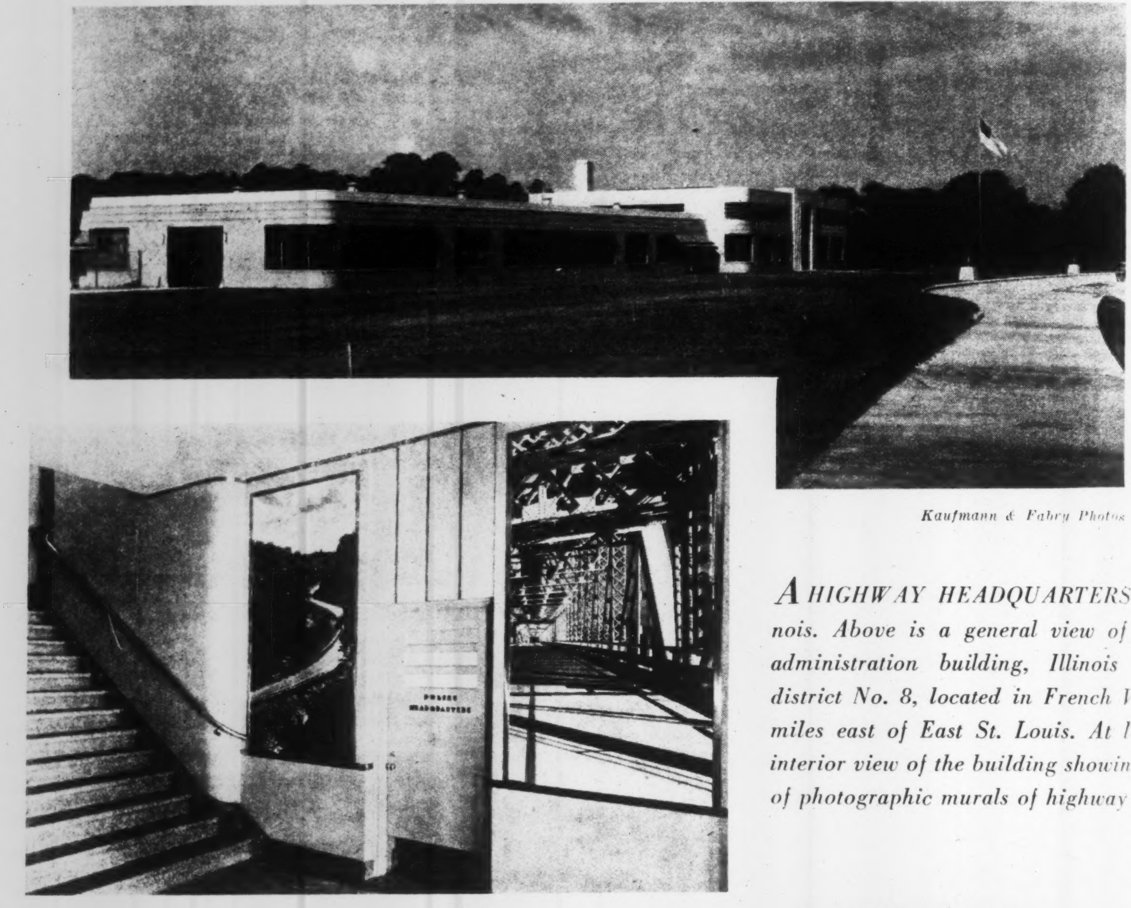
Worth Paying For

NOW THAT CHICAGO and New York have been added to the large number of cities whose building codes permit structural welding, it is well to emphasize again a fundamental requirement, namely, that inspection is the most important part of the process. Although the necessity of inspection is widely recognized, it is not so certain that equal recognition is accorded the fact that welding inspection, if adequately thorough, costs more than riveting inspection; 50 per cent more as a probable minimum.

Inasmuch as the competition between welding and riveting will often be on a price basis, it is important that no saving be figured on the welding inspection. Rather, it must be admitted that any calculated saving from welding must be reduced by the amount of an extra charge for inspection. It is probably correct to say that the most thorough job of field inspection of riveted joints is not thorough enough for the field inspection of welding. Visual methods of weld inspection have been developed to a high state of excellence, but since they are visual every inch of every weld must be scrutinized carefully and closely. No long-distance, hit-and-miss, lick-and-promise methods can suffice.

Without detracting from the importance of efficient joint design or proper welding technique, inspection must be accorded major attention if structural welding is to gain the acceptance that it deserves. It is not unreasonable that such an important part of the welding procedure should cost more than its less important counterpart in riveted construction. But whether it is reasonable or not, it is necessary. Welding must have the benefit of adequate inspection.

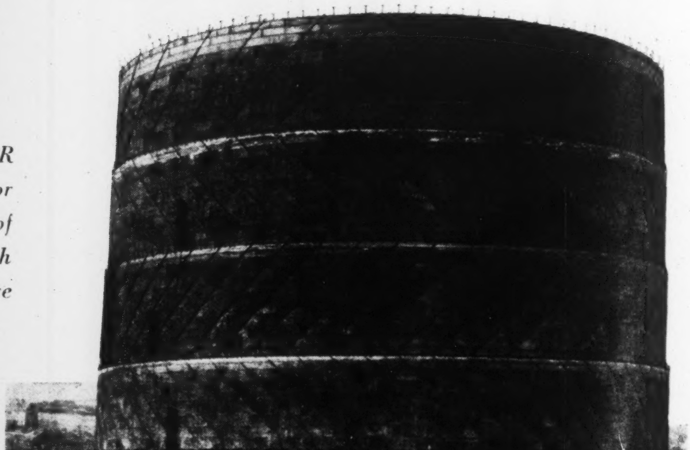
PICTURES IN THE NEWS



Kaufmann & Fabry Photos

A HIGHWAY HEADQUARTERS for Illinois. Above is a general view of the new administration building, Illinois highway district No. 8, located in French Village, 5 miles east of East St. Louis. At left is an interior view of the building showing the use of photographic murals of highway projects.

LARGEST SPIRAL-GUIDED GASHOLDER yet built is this 8,000,000-cu.ft. installation for the Sheffield Gas Co. in England. This type of holder has not been used in the U. S., although there are several in Canada. Spiral guides are used to eliminate exterior guiding framework.



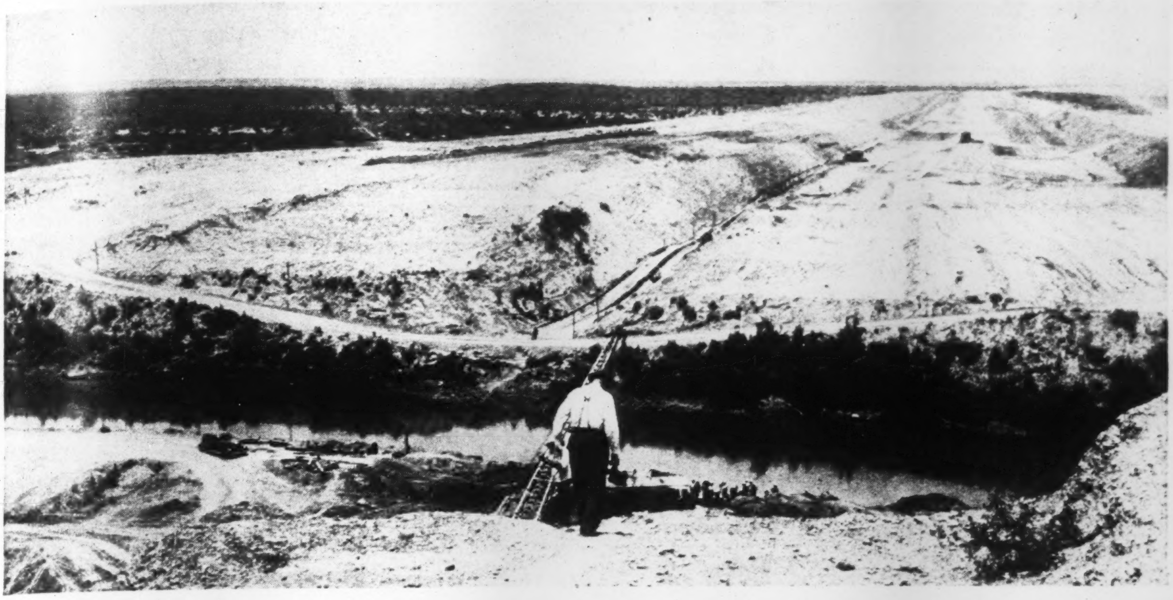


FIG. 1. EL AZUCAR DAM SHOWING CORE TRENCH AND PART OF ROLLED FILL

Building El Azucar Dam

Some notes of a visit to Mexico's great rolled-fill dam El Azucar being built to put a quarter of a million acres under irrigation just south of the Rio Grande

Some 25 miles south of Rio Grande City, Tex., the Mexican national government is building a rolled-fill earth dam across the San Juan River to impound 1,700,000 acre-ft. of water with which to irrigate 247,000 acres of land on the south side of the Rio Grande downstream from the San Juan. In May when it was visited the dam as a whole was one-third completed with work progressing on all phases but mainly on excavation and fill. The diversion tunnel, laboratory controlled compaction, borrow pit selection and control, cutoff wall and combination outlet and spillway were all in the active construction stage. A day's observation of these busy operations gave a vivid picture of modern dambuilding as it is conducted by our Mexican neighbors.

As the work is being done by day labor, with 1.500 men on the payroll, it was not surprising to see a camp housing 4.500 to 5,000 people and assuming the proportions of a city with the usual recreation and commercial facilities. It was something of a surprise however to see men working and work progressing regardless of the fact that the last pay day was 6 weeks overdue. But Mexican labor relations are not the present subject.

Making the big fill

The dam is 3 2/3 miles long and 138 ft. high at the river bed with a crest width of 26¼ feet. It calls for 5,625,000 cu.yd. of fill. The sections of pervious and semi-pervious materials selected and compacted to suit the different positions in the dam are shown in the accompanying cross-section (Fig. 2). A rock riprap face a meter thick (Fig. 3) lines the upstream face down 70 ft. below high-water level. For the main body of impervious clay, tamping rollers of the sheepsfoot type pass twelve times to give a density of 115 lb. per cu.ft. with 14 per cent average moisture. Over the cutoff trench and wall the rollers pass fifteen times, but in the semi-pervious sections the passes were cut to ten. Waste material on the downstream toe which was laid on a 1 on 6 slope was not compacted. The same material on the upstream toe is compacted ten times with tamping rollers.

The rolling is done with 42-in. diameter sheepsfoot rollers drawn by tractors, the rollers being weighted with gravel to produce a pressure of 270 lb. per sq.in. on the face of the 2½x4-in. feet when new. The original feet last about 3 months before having to be built up by welding in the shop. With hard facing material they last about 6 months, but special manganese steel block faces of which a carload has recently been imported from the States are expected to last out the job.

The material is hauled in by trucks and spread in layers 6 to 8-in. deep by bulldozers. Most of the moisture

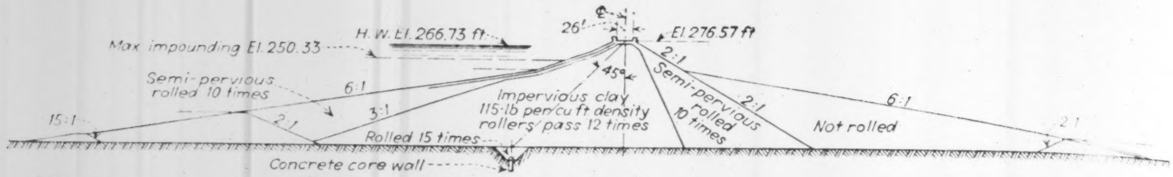

H. W. El. 266.73 ft
26'
El 276.57 ft
Max impounding El. 250.33
2:1
45°
Semi-pervious rolled 10 times
6:1
Semi-pervious rolled 10 times
2:1
6:1
Impervious clay 115-lb per cu ft density rollers pass 12 times
15:1
2:1
3:1
Not rolled
2:1
Rolled 15 times
Concrete core wall

Fig. 2. El Azucar dam in cross-section of fill follows recent practice in varying fill material and degree of compaction

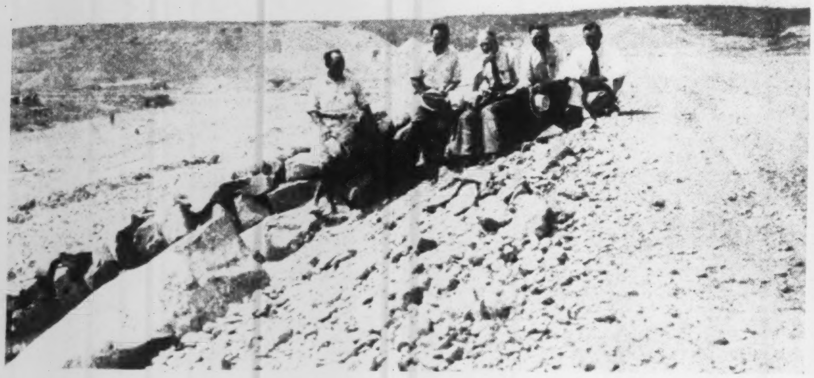


Fig. 3. Upstream the slope of El Azucar dam fill is paved with heavy stone

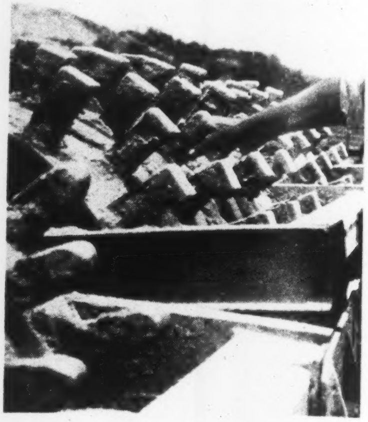


Fig. 4. Old worn roller feet and new feet of manganese steel that are now being substituted

is applied in the borrow pits by ponding and keeping the surface covered for 6 days. On occasion moisture penetrates deep enough to permit the shovels to make three 6 to 8-ft. cuts. The shovels on the job are old equipment used on the Don Martin dam by The J. G. White Construction Co. and are diesel-operated with 1½-yd. buckets. They load 1,000 cu.yd. per 8-hr. shift into privately owned 2½-ton trucks. Pay to the individual truck owners is 50 centavos per meter per kilometer hauled, with 20 centavos per additional kilometer. The government owns only 23 trucks, the superintendent preferring that most of the hauling be done by individual owners. Incidentally, exchange was about 4 to 1 at the time of the visit and in consequence, dollars with which to buy equipment in the States come high and many replacements are homemade in the excellent shop originally set up 1½ years ago when the job started.

Diverting the San Juan

The diversion tunnel which is to be lined with concrete but is not to be retained for ultimate diversion of irrigated water is a 6-meter bore of horseshoe section 1,370 ft. long, driven through a dark-colored, closely-compacted, impervious sandstone and limestone formation locally called mudstone. Most of the excavation is by jackhammers but in the harder parts black powder in small shots is used. The material apparently does not slack like shale but breaks easily without much stratification showing. Although the material does not fall, heavy 12x12-in. timbering on 42-in. centers is set. A single crown piece is placed first in the pilot cut 6.56 ft. wide and 7.2 ft. high. This cut was two-thirds of the way through in May.

Widening of the upper bench and setting the remainder of the 5-piece arch section of timbering on 12x12-in. side plates was only well started. The bench had been removed for only a few feet. The transition which is 33 ft. at the face of the entrance and reduced to the regular 20-ft. section is to be reinforced but no steel is to be used in the regular section. Concrete will cover the timbers 4 in. and fill in the space between timbers back to the rock. Thus in effect there will be alternate ribs of concrete and original wood sets.

Three compressors furnish air for the jackhammers and drills. No other ventilation was available, blowers being on order but hardly expected before the pilot tunnel, then two-thirds of the way through, was completed. While the tunnel was hot and moist it was not unbearably so and no complaints were being registered. Mucking was by wheelbarrow to the entrance where trucks were loaded by hand.

Checking underflow

The foundation of the dam was thoroughly explored by 4-in. calyx drill holes spaced 164 ft. apart along the axis of the dam. At 328-ft. intervals along the axis three holes upstream and two downstream from the axis furnished a close picture of the underlying strata. In each case the holes were sunk to the impervious mudstone which is fairly level 60 to 80 ft. down. Above it, pervious lenses of open gravel and wet sand were found. The bed of the river is in this mudstone which is of indefinite depth without pervious lenses.

In consequence of these explorations the engineers decided to sink a cutoff wall to the mudstone throughout the length of the main dam. A trench 65½ ft. wide on top was excavated 33 ft. deep with a dragline, and a 3.28-ft. wide trench 30 to 60 ft. deep was sunk by hand half a meter into the mudstone formation. This trench was through a 6½ to 16-ft. stratum of sand and gravel from which water was handled by four 2-in. centrifugals with only two ordinarily needed. Two of these pumps were driven by air power. Concrete made in a central plant was hauled to the top of the cut and chuted to place in the cutoff trench.

The wide cut of the dragline with 1 to 1 side slopes gave a good berm on which the excavation from the trench was wasted by hand until the trench was filled with concrete. Then trucks removed it before bringing in material from the borrow pits for compaction. Loose material and large gravel compacted in clay, making almost a conglomerate, was being removed from the river channel section by shovels to trucks and hauled to spoil banks or to blanket the toes of the finished dam in 1 on 6 slopes.

Outlet spillway

The combined outlet and spillway is located in a saddle some distance north of the end of the north embankment. A cut of 26 to 98 ft., made by shovels and trucks, was being excavated for a spillway 529 ft. wide across which are to be placed a row of nine 50x50-ft. stoney gates between concrete piers 9.8 ft. wide. The outlet capacity of the spillway is 742,000 sec.-ft. into a stilling pool 52 ft. deep and 328 ft. long on the bottom. This is equivalent to 57 sec.-ft. per sq.mi. over the 13,000 sq.mi. of watershed from which the available record runoff has been 353,000 sec.-ft. at the damsite. The cross-section through the spillway indicates a free-board of 10 ft. to the crest of the dam above the assumed highwater level. The maximum storage level is 16.4 ft. below the highwater level at which elevation the 1,700,000 acre-ft. storage is available in the 50 ft. depth to the sills of the spillway gates.

Regulation of the outlet water for irrigation will be through a tunnel 16½ ft. in diameter and an intake tower, located in the right bank of the river. The sill of the tower's gates will be at El. 60.

Excavation quantities for the outlet works run high. The inlet canal excavation is 1,700,000 cu.yd.; structures, 1,046,000 cu. yd. and ½-mi. discharge canal, 785,000 cu.yd. A concrete apron extends 130 ft. upstream from the gates and about 200 ft. downstream to the stilling pool, the remainder of which will be riprapped with rock. These dimensions were still under discussion and dependent on findings after fully excavating to grade. The inlet canal is 666½ ft. wide on the bottom with 1½ to 1 side slopes. The outlet canal is 528.7 ft. wide on the bottom with 1 to 1 slopes.

Construction of El Azucar dam is being carried out by the Comision Nacional de Irrigacion, whose director is Francisco Vazquez del Mercado. The superintendent is Max W. King and his assistant is Manuel Zuazua. Isidro Diaz is resident engineer and David Herrera Jordan is his assistant. The consulting engineers are Andrew Weiss and Cesar Jimenez Lopez.

Tunnel Men Fight Water to Regain Tunnel Face

Unwatering the East River Tunnel heading successfully accomplished after hazardous work in sealing riprap face and joint at tail of shield

RECOVERY of the drowned-out north Manhattan heading of the East River vehicle tunnel at New York, briefly reported in our news pages last week, involved unusually difficult and painstaking operations. The upper half of the face at present is in riprap which, until sealed, passed water and air freely and rendered ineffective all attempts to lower the water in the tunnel.

The heading was drowned out on the morning of Monday, June 27, following a fire in the heading on the previous evening (*ENR* June 30 and July 21, 1938, pp. 889 and 67). Efforts were made to control the fire by pumping in water and by dropping the air pressure to allow river water to enter through the heading face. The following morning a sudden blow occurred and the tunnel filled except for a pocket of air about 8 ft. deep at the lock.

At this time the north and south tunnels, which are 31 ft. in outside diameter and 30 ft. apart in the clear, had advanced about 275 ft. from the air-locks and their heading faces were a short distance outshore of the river bank. It was considered unsafe to undertake recovery operations on the north tunnel until the south tunnel had been advanced out of the open ground. Since that time the south tunnel face has been advanced about 80 ft., practically all the way through a mixture of riprap and river-bottom muck, which presented exceptional difficulties and hazard.

Three weeks ago the first attempt was made to pump out the north heading and raise the air pressure, but the attempt was unsuccessful, as the face allowed water to enter and air to blow out freely. Thereupon a barge was anchored over the tunnel and the material just ahead of the face was grouted through pipes driven down from the surface, which produced a sufficient seal to permit of starting operations inside.

The final attempt at recovery was begun Aug. 7, by pumping down the water and simultaneously raising the air pressure sufficiently to lower the water 2 to 3 ft. below the crown. Men then went in through the emergency (upper) airlock and floated along the tunnel in rafts, taking with them lengths of plank, packing material and clay for bulkheading and sealing. Finding that the joint between the front ring of the lining and the tail of the shield was blowing air in large volume, they packed this joint with bagging and a deep seal of clay. Then they proceeded to bulkhead and pack the upper pockets of the shield, and to grout the face more thoroughly through pipes run through this bulkhead.

It was now possible to pump down the water and raise the air pressure and to pack the next lower line of shield pockets. Below the centerline, however, the tunnel was filled with a muck deposit tapering back almost to the airlock bulkhead. Attempts to lower the water below the centerline started an inward movement of this material, and in order to hold it a bulkhead of planks was driven down through the muck filling just back of the shield. With this as support, it was possible to clear the tunnel of water and raise the air pressure. Unwatering was completed by Aug. 10.

The grouting through the shield pockets had consolidated the face sufficiently to permit removing the packing of the pockets and clearing the face. It was found that the upper part of the breasting and the walling timbers were charred, and some of them were broken and had been forced forward and upward into the ground. This material and the stones and boulders of the face were well embedded in a fairly strong grout, however, and it was possible to clear the face progressively downward.

Examination of the tunnel and equipment showed that bales and bags of hay and bags of sawdust stored on the grouting platform 50 or 60 ft. back of the shield were consumed, and that much of the planking of the bolting and working platforms thence forward to the shield had also been burned on the upper face and part of the bolting platform floor had been broken down. Landward of the grouting platform there was little evidence of fire except some soot deposit on the roof. The edges of a few of the hemp grommets under the washers of the lining joint bolts were charred. The fire apparently traveled forward from the hay on the grouting platform to the face, driven by the flow of the air outward through the face. Nothing was found to indicate how the fire started.

Present operations in the tunnel comprise cleaning out the muck accumulation in the bottom and gradually placing new breasting and packing at the face. Work has to proceed with extreme skill and care, especially in removing any stone or other large piece of material in the face. In taking out such a piece it must be kept practically covered with clay, and the clay must be worked in around and back of it progressively as the piece is removed, at the risk of developing a hole and blow.

J. A. McDonald is in charge of the tunnel work and Harry Redwood is superintendent for the Walsh Construction Co., contractors. For the New York City Tunnel Authority Ole Singstad is chief engineer. Jacob Mechanic is engineer of construction.

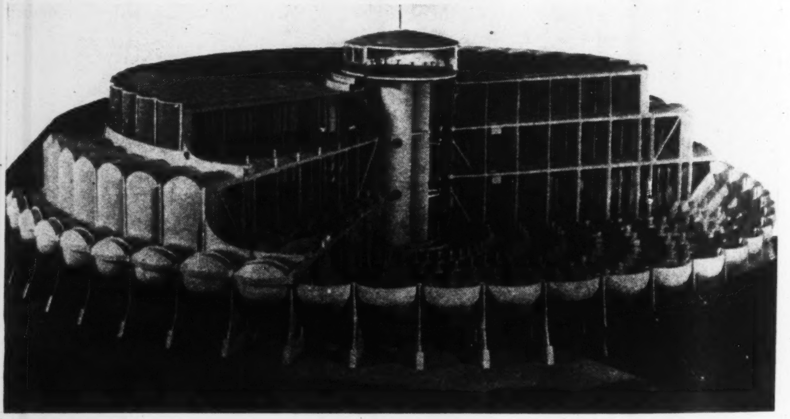
A Three-Story Reservoir of Novel Construction

UNIQUE among waterworks structures is the three-story reservoir recently completed at Nantes, France. Built of reinforced concrete, the structure consists of thin arch sections supported by beams and buttresses. The total capacity of the reservoir is 10.5 million gallons and the design is such that the three basins can be independently filled and emptied.

The lowest basin has an outside diameter of about 243 ft. and it is made up of a series of 50 arches. Each arch has a span of 11.5 ft. and is inclined at an angle of 45 deg. Because of the form and thinness of the arches, each of them can be deformed independently without any danger to the structure.

The middle basin of 216 ft. in diameter has sides which are composed of thin vertical arches. The floor of this basin is formed by segmental arches, part of which extend beyond the walls to form a roof for the lower basin (Fig. 1 top). Construction of the top basin is patterned after the others. It has a diameter of about 179 ft. Connecting the three basins is a tower in the center of the reservoir. This houses three vertical wells which contain valves for the three systems of distribution.

The pictures and data were furnished by G. Le Marec, technical director of the Enterprises Limousin, designers and builders of the tank.



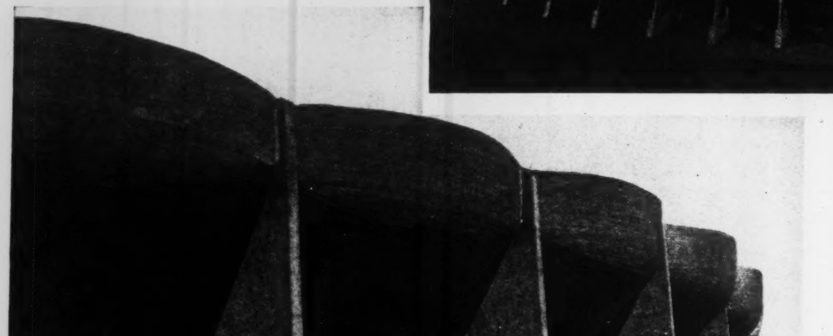


Fig. 1. Design features of the Nantes, France, thin arch circular reservoir which has three superimposed storage compartments. (left) Buttress construction which supports concrete arch sections.

Three Major Bridges Completed This Month

St. Lawrence River at the Thousand Islands in New York, St. Clair River at Port Huron, Mich., and the Connecticut River at Middletown, Conn., are scenes of construction achievements

BY COINCIDENCE, three of the major bridges that have been under construction in the northeastern part of the country during the past two years were brought to completion this month. All three are described in the articles that follow, each article emphasizing that phase of the work on a particular bridge that is of most interest and significance.

Two of the bridges are international structures, the Bluewater Bridge connecting Michigan with Ontario and the Thousand Islands Bridge joining New York with the same Canadian province. The former bridge will replace a ferry across the St. Clair River, the latter provides a wholly new crossing of the St. Lawrence River. Both are toll structures, financed in large part by revenue bonds.

The third bridge, over the Connecticut River at Middletown, Conn., is a free, state highway bridge which owes its existence to the fact that the great flood of March, 1936 flowed over the floor of the adjacent old bridge, dramatically emphasizing its inadequacy. The new bridge floor is 50 ft. above this record highwater mark.

Five Bridges in One

Thousand Islands Bridge involves two suspension bridges, a steel arch, a continuous truss and a rigid frame concrete span

RISING HIGH on graceful suspension spans over the Canadian and American channels of the St. Lawrence River, winding across wooded islands on new connecting roads, and spanning placid waters by short structures between adjacent islands, the Thousand Islands Bridge project breaks a main traffic barrier between the United States and Canada. Located in the heart of the historic and scenic Thousand Islands region, the new crossing extends for 7 miles—7,920 ft. of it on structures—from Collins Landing, near Alexandria Bay, New York, to Ivy Lea, below Gananoque, Ontario. The series of bridges is the only physical connection between the two countries along 325 miles of water-bound international boundary, extending from Lewiston, N. Y., on the Niagara River, through Lake Ontario and down the St. Lawrence to Cornwall, Ontario, near the New York-Quebec border. At Cornwall, highway traffic uses a plank-decked railroad bridge when the trains aren't using it; otherwise, up to now, there has not been a highway crossing of the river between Montreal and Lake Ontario.

Not only will the new crossing provide a direct route between northern New York and eastern Ontario, but it also gives access by car to two of the larger islands. One of the objectives of the project will be to develop this scenic region as a recreational and tourist area. In a 55-mile stretch of the river, from Lake Ontario to Brockville, Ont., there are 1,692 islands ranging in area from rocky points to 20,000 acres. Distance between river banks varies from 1 to 10 miles. Many of the islands and parts of the mainland are already designated as state and provincial parks, and local interests on both sides of the river are working to have the public domain enlarged.

History

Bridging the St. Lawrence River at the Thousand Islands has been considered for more than 50 years. One of the original proposals was that of Capt. Alexander Farlinger, who secured a charter about 1882 under the name of the Ottawa, Waddington and New York Railway & Bridge Co. This charter lapsed when the railroads changed their plans and finally built the bridge at Cornwall.

In 1888, plans were proposed for a railway bridge at Ogdensburg. This never materialized, but in 1895 a bridge was actually started between Brockville, Ont., and Morristown, N. Y. One pier completed at that time is still standing. In 1915, a crossing was proposed for the narrows above Brockville, and in 1929 a company obtained a charter in both Ottawa and Washington for a revival of this project.

In 1926 and again in 1927, private interests were blocked by New York State to obtain rights to build a toll bridge near the site of the present one. The state set up a commission in 1930 to investigate the various possible bridge locations, and reports covering six sites were filed with the legislature that year.

Actual promotion of the present project started in 1932 when citizens of Watertown, N. Y., succeeded in

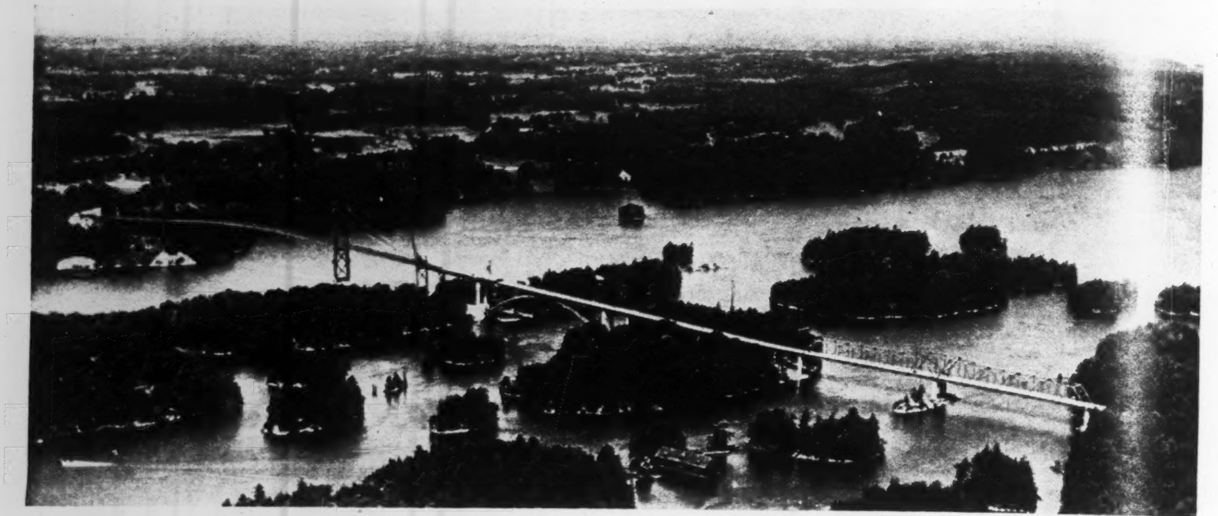


Photo by A. W. Santway, Watertown, N. Y.

Fig. 1. Three of the five bridges that make up the Thousand Islands Bridge. These are over the Canadian half of the St. Lawrence River.

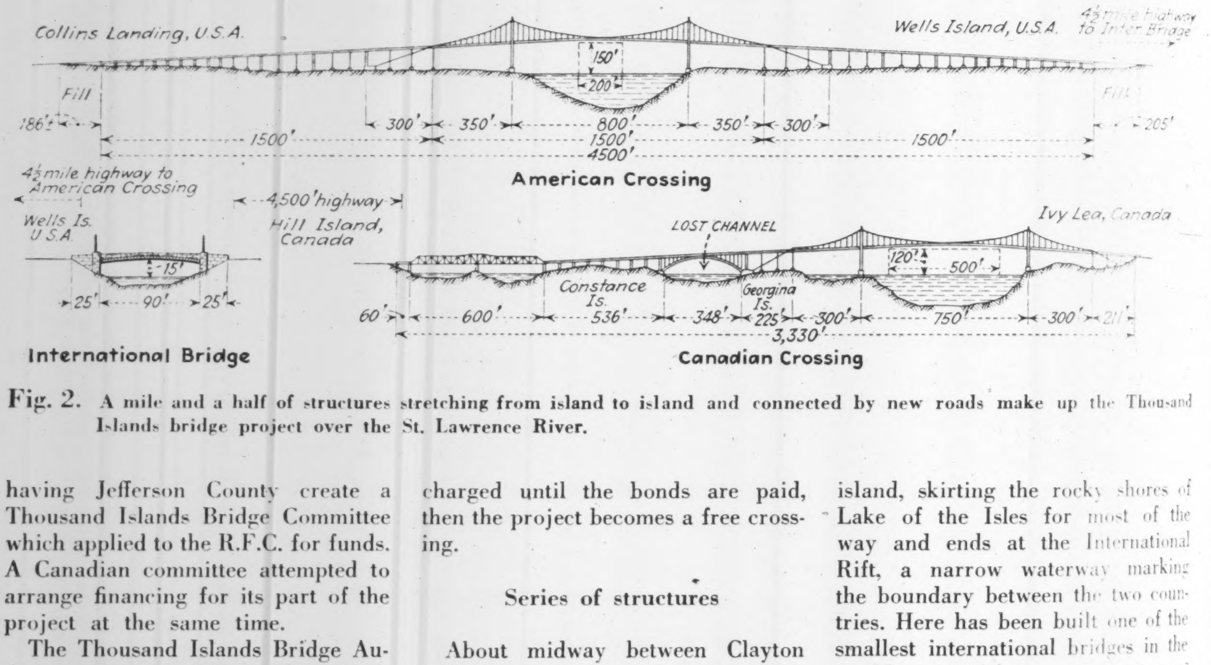

Collins Landing, U.S.A.
Wells Island, U.S.A.
4½ mile highway to Inter. Bridge
150'
200'
Fill
Fill
186'±
300'
350'
800'
350'
300'
205'
1500'
1500'
1500'
4500'
American Crossing
4½ mile highway to American Crossing
4,500' highway
Wells Is. U.S.A.
Hill Island, Canada
LOST CHANNEL
Ivy Lea, Canada
15'
120'
500'
Constance Is.
Georgina Is.
25'
90'
25'
60'
600'
536'
348'
225'
300'
750'
300'
211'
3,330'
International Bridge
Canadian Crossing

Fig. 2. A mile and a half of structures stretching from island to island and connected by new roads make up the Thousand Islands bridge project over the St. Lawrence River.

having Jefferson County create a Thousand Islands Bridge Committee which applied to the R.F.C. for funds. A Canadian committee attempted to arrange financing for its part of the project at the same time.

The Thousand Islands Bridge Authority was created by the New York state legislature in 1933, and at the same time a private company in Ontario was authorized to build the Canadian structure. Subsequent state, provincial and federal legislation in both countries enabled transfer of the Canadian rights to the American authority. Unsuccessful attempts were made to secure PWA funds, and finally revenue bonds, aggregating $3,050,000, were sold by the Authority.

Ground was broken on April 30, 1937, the last day permitted under the federal franchise. Tolls will be charged until the bonds are paid, then the project becomes a free crossing.

Series of structures

About midway between Clayton and Alexandria Bay, a short stretch of new highway leads off from New York Route 12 to the approach of the American channel span. This approach is a 1,500-ft. deck girder viaduct rising on a 5½-per cent grade to meet the suspended span.

The American suspension bridge has a center span of 800 ft. and side spans of 350 ft. each. Another 1,500 ft. of steel viaduct carries the roadway down to Wells Island, whose 10,000-acre area makes it the largest in the American group. From the end of this bridge a 4½-mile highway, built by the state, winds across the island, skirting the rocky shores of Lake of the Isles for most of the way and ends at the International Rift, a narrow waterway marking the boundary between the two countries. Here has been built one of the smallest international bridges in the world, a rigid-frame concrete structure of 90-ft. span, faced with pink granite blasted from the site. Two bronze plaques on the inside face of the stone railings and a bronze strip extending diagonally across the floor slab indicate the exact location of the boundary.

From the Canadian end of the International Bridge a new road, built by the Province of Ontario, extends for 4,500 ft. across rocky Hill Island to meet the Canadian series of bridges. The first or southerly structure is a two-span continuous through truss, 600 ft. long, supported on a center pier resting on a tiny island. The north end of this bridge touches Constance Island, which is crossed by a deck girder viaduct, 516 ft. long, tying in with a 348-ft. steel deck arch spanning Lost Channel.

The north abutment of the arch, on Georgina Island, is a three-service structure (Fig. 4), taking the thrust of the arch, supporting a high concrete pier for the viaduct approach to the Canadian suspension bridge, and serving as the south anchorage for this bridge. The main Canadian bridge is similar to the American span except for length, having a center span of 750 ft. and side spans of 300 ft. A curving steel viaduct, 211 ft. long, lands the roadway on the Canadian mainland.

To provide direct access to the bridge, the provincial government is relocating King's highway No. 2, the main transcontinental route, for 28 miles. In keeping with the scenic beauty of the north shore, the new route is a four-lane parkway, with numerous turnouts and parking spaces.

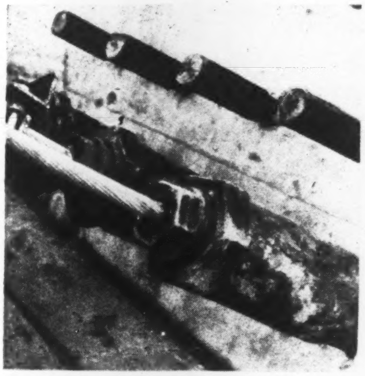


Fig. 3. Threaded sockets connected to threaded anchor bars by adjustable sleeves form a new type of cable anchorage.

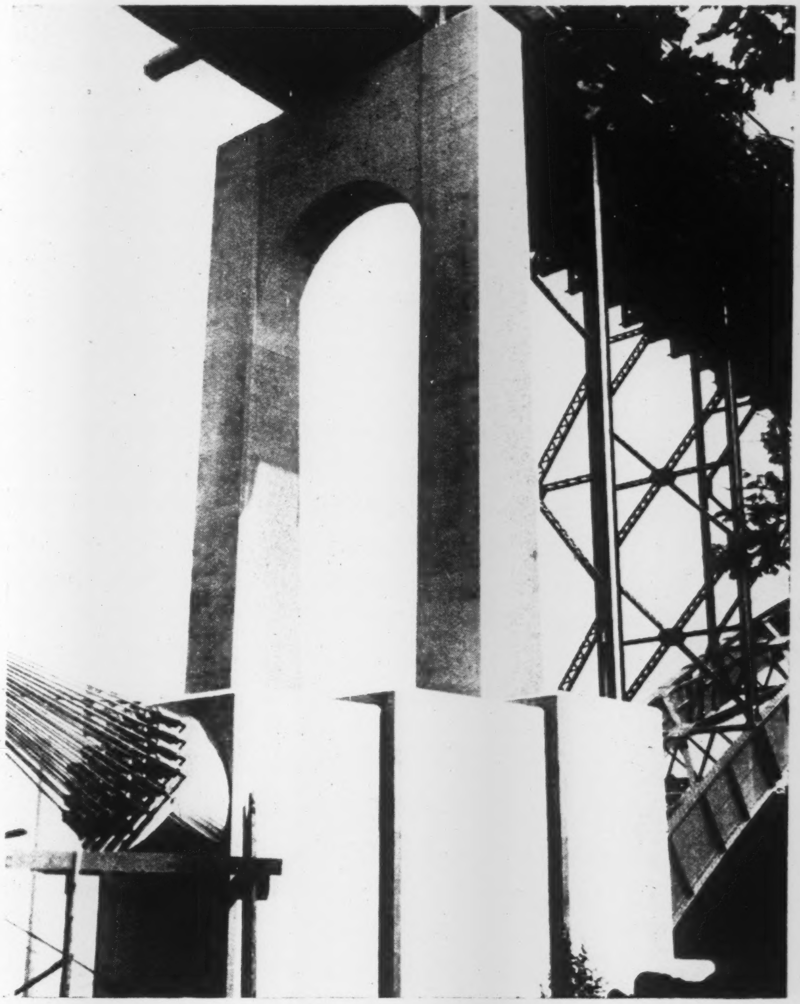


Fig. 4. Combination cable anchorage, arch abutment and viaduct pier base in the Canadian group of structures.

Details of design

The designers of the project were faced with several basic problems. First was the economics of the scheme, for not only were available funds limited, but as the project was to be self-liquidating, costs had to be kept down to permit reasonable tolls. Next was the question of design that would harmonize with the scenic surroundings. Another problem was that of navigation clearance—150 ft. for a 200-ft. width over the American channel; 120 ft. for 500 ft. over the Canadian waterway.

Studies showed suspension bridges were most economical for the main channel spans, and they not only easily provided the required navigation clearances, but their design blended best with the natural surroundings. Cantilever, arch and simple truss designs were also considered. The two main bridges are similar in design except for length and tower height. The cables, 30½ ft. apart, are 7½ in. diameter, each composed of 37 prestressed strands of 1¼-in. wire rope, arranged in hexagonal pattern. Final treatment of the cables includes painting, then wrapping with wire around wooden fillers to form a circular finished section, 9 in. in diameter.

The anchorages consist of 2⅜-in. steel bars at each end of each strand, deeply embedded in concrete. The bars, in hexagonal arrangement, converge as they leave the anchorage to meet the diverging strands of the cable. The strands terminate in cast-steel sockets, externally threaded. These are fastened to the upset and threaded ends of the anchor bars by an internally threaded sleeve which permits adjustment of the strand length by turning with a wrench (Fig. 3). After the strands were adjusted to length, the sleeves were spot welded to keep them from turning.

The main towers are two-post bents, with x-bracing below the roadway and lattice girders at the portal and at the top. On the American span the towers rise 251 ft. above water; on the Canadian span 220 ft. The long approaches on both sides of the American channel bridge are three-span continuous deck girders. Every third pier is a concrete bent to allow for expansion of the approach structure; intermediate piers are flexible steel bents. The shorter approaches to the Canadian bridge are simple-span deck girders on concrete piers.

On both suspension bridges the roadway is 22 ft. wide between curbs, flanked by 3-ft. sidewalks. To allow for a full view from the roadway, the stiffening plate girders were held to 6-ft. depth, and the cross beams are set high to place the roadway slab near the top of girders. An open pipe railing guards the sidewalks without obstructing the view. On the suspended spans the roadway is a 4-in. armored concrete slab; on the approaches and the other steel structures it is 8-in. reinforced concrete.

The 600-ft. continuous Warren truss span was kept as low as possible for the sake of appearance. First designs for the structure over Lost Channel called for a through truss, but later studies showed this location ideal for a steel arch.

Foundations

Substructures were relatively simple, for rock was found at or near the surface for all main foundations except the New York shore anchorage which is founded on steel H-section piles, both vertical and battered to take the cable thrust. A fortunate discovery of an uncharted shoal offshore from the south side of the main Canadian channel simplified the design of the structure at this point, for by founding the south pier on the shoal and the cable bent on the shore, the south anchorage could be located far enough away to permit a satisfactory slope of the cables. The pier on the shoals required a cofferdam only 14 ft. deep.

Construction

There were no outstanding construction problems involved in the project. The American suspension bridge was built by contractors from the United States; the Canadian structures and the International Bridge by firms from Ontario. American labor was used exclusively on the American span, Canadian labor on the Canadian bridges, and workmen from both countries on the International Bridge.

Construction features of the American bridge included pumping of all the concrete for the main foundations and the high approach piers. Because the channel on this side is the main navigation lane, it was impossible to anchor the steel supply barges in midstream, so steelwork for the stiffening girders and floor had to be run out from shore on lines from the cables. No such restriction prevailed on the Canadian spans, so the steel was hoisted from barges. Electric power was available from the New York side, but all construction equipment on the Canadian bridges was powered by steam or gasoline. The arch was erected by the tie-back method; falsework was used for the truss span erection.

Direction

The Thousand Islands Bridge Authority, set up by an act of the New York state legislature, includes E. H. Miller, F. J. Martin, Leon Schwerzmann, E. C. Sawyer, and Ross Parker. W. G. Mitchell is executive secretary. Design of the entire project and supervision of construction were by Robinson & Steinman, consulting engineers of New York City. Monsarrat & Pratley, Montreal, were associate engineers. William T. Field, of Watertown, N. Y., who was one of the leaders in promotion of the project, was retained as advisory engineer by the Authority. R. Boblow represented the consulting engineers as resident engineer directly in charge of the job and J. London was in charge of the office force on design.

The contractors on the structures were: American span substructure, Dominion Construction Co., Niles, Mich.; American span superstructure, American Bridge Co., and Street Bros. Construction Co., Syracuse, N. Y., subcontractor on the roadway; foundations for Canadian bridges, Cameron & Phin, Welland, Ont.; Canadian superstructures, Canadian Bridge Co., Walkerville, Ont., and Cameron & Phin, subcontractor on the roadway. The International Rift bridge was built by R. A. Blythe, of Toronto.

Economy and Good Appearance Rule Cantilever Design

Bluewater Bridge between Michigan and Ontario sets a new style in line and proportion

In designing the new international bridge over the St. Clair River between Port Huron, Mich., and Sarnia, Ontario, finished this month, the engineers and architects exerted every effort to produce a cantilever design that would dispute the reputation for ugliness that is usually attached to this type. That their efforts met with considerable success is evident from the accompanying photograph of the finished structure. It is also worthy of note that the attempt to provide the bridge with a good appearance did not increase its cost but rather resulted in a more economical and efficient structure.

Named the Bluewater Bridge because of the clear blue character of the stream which it crosses, the bridge has an 871-ft. main span, extending from shore to shore, and 326-ft. anchor arms. A deck girder approach, including two deck truss spans adjacent to the main bridge, totals 2,657 ft. on the Canadian side, and a similar layout is 2,283 ft. long on the American side, bringing the total length of the bridge to about 1¼ miles. The main span clears the river by 150 ft. to accommodate the heavy shipping that plies beneath it between Lake Huron and Lake Erie. The roadway (of concrete-filled steel-grid type on the main span), is 32 ft. wide, and there are two sidewalks—4 ft. 2½ in. and 1 ft. 8½ in. in width.

Before choosing a cantilever design, other types of bridges were studied. Foundations were found to be unsuitable for an arch. The relatively short span in combination with the high shipping clearance defied the use of a suspension bridge that

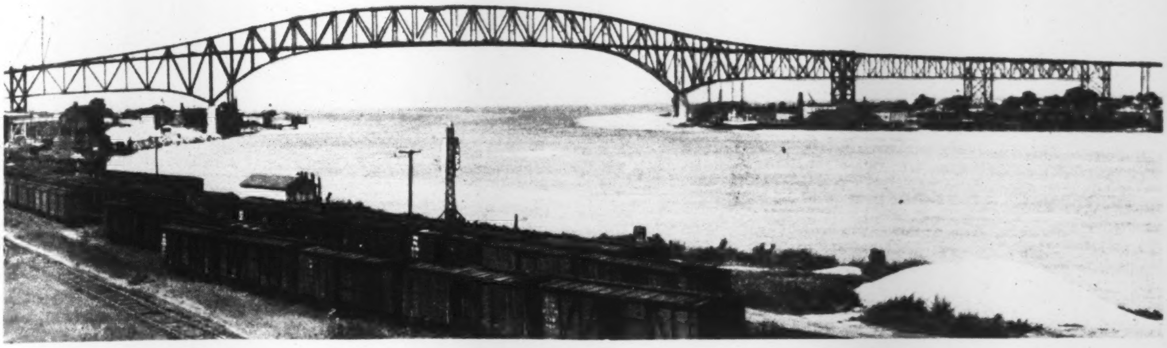


Fig. 1. **Providing 150-ft. clearance over the St. Clair River, the Bluewater Bridge presents an interesting outline featured by a flat-arch cantilever central span and steel framed anchor towers.**

would not look freakish; and moreover, the high cost of anchorages made the suspension design uneconomical. A cantilever design proved to be best suited to conditions, was least costly and could meet the requirement of construction without falsework in the river. The principal problem was to work out such outline and proportions that the bridge would have esthetic appeal.

Detailed study of the cantilever type brought out the possibility of developing an outline which, in combination with the anchor arms, would suggest a three-span continuous truss with an arched center span. Whereas in most such cantilever designs, the bottom chord of the main span trusses is carried above the roadway to suggest an arch, the bottom chord of the Bluewater Bridge was kept slightly below the level of the roadway, curved at the ends but practically horizontal over the center half of the span for a width sufficient to provide navigation clearance. By this expedient, the material that would have been required in the conventional arch cantilever for hangers and for wind chords in a bottom lateral system was saved. In addition, the height of the structure could be made a minimum consistent with the vertical clearance required, thus keeping wind stresses throughout the main span low in comparison with the other types of structures studied. Finally, an agreeable simplicity of appearance was created.

Another feature of the design that enhanced the appearance of the bridge is evident at the anchor arm piers, which mark the transition between the main bridge and the approaches. The difficulty of making a suitable transition at this point was increased by the fact that the trusses of the main bridge are 40 ft. 7 in. apart and outside the roadway and sidewalks, while the approach trusses and girders are only 29 ft. apart and support an overhanging deck. An original design placed a high masonry pier at this point but the final studies substituted a structural steel tower on a short pier. Such a steel tower, with short architectural posts projecting above the roadway, furnishes the necessary defining feature at the end of each anchor arm and at the same time fits in naturally between the anchor arm truss and the approach truss. The transition is aided by continuing the chords of the approach trusses on the same lines as those of the anchor arm chords.

In its structural details the bridge is not particularly unusual. There is a liberal use of silicon steel. The main bridge truss members are built-up sections and most of the Canadian approach work is of the same design since rolled beams in the larger sizes are not available in Canada. In the American approach, however, rolled sections predominate.

One interesting detail in the approach girder spans permits the saving of a floorbeam at each girder end where expansion does not occur. In general, the approaches consist of groups of three simple girder spans, from 61 to 78 ft. long, supported on bents, with braced towers of 44 ft. span placed between the groups. The girders are fixed at each tower bent and expand toward that bent which

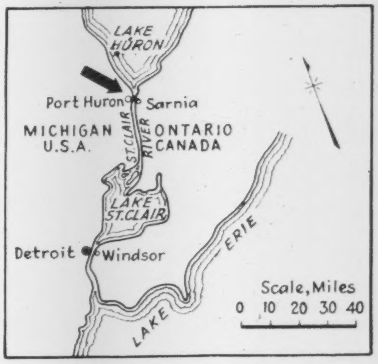


Fig. 2. **Location map of Bluewater Bridge joining Port Huron, Mich., and Sarnia, Ont.**

is one span removed from the tower on its high side. Whereas each point of fixed support would normally have a double floorbeam and a fixed bearing under each girder span, a strap is used to tie the top flanges of the girders together at these points, permitting a continuous floor system with a single floorbeam over the support, but requiring a bronze sliding bearing under one of the girder ends to allow for girder deflections. Two floorbeams are, of course, used at the expansion bents.

Other facts about the bridge

The two main bridge piers, each consisting of two 26-ft. dia. caissons with 8 ft. dredging wells, were sunk to rock at a depth of 95 ft. below low water level. Above the ground the caissons are surmounted by two shafts about 50 ft. high tied together at the top with a cross strut. The Michigan approach piers are on spread footings and, except for a few pile-supported piers, the Canadian approach foundations are of the same type.

Toll collection, customs, immigration and administration facilities are provided at both ends of the bridge. The Michigan plaza is an elevated area of flat slab design, 120 ft. wide at the toll booths, and connected by ramps to the Port Huron streets.

The bridge will be lighted with sodium vapor lamps on two circuits, one from each side of the river.

Engineers and Contractors

Engineers for the design of the entire structure and for the supervision of the construction of the main bridge were Modjeski & Masters, formerly Modjeski, Masters & Case, who had as their Canadian associates the firm of Monsarrat & Pratley. Paul P. Cret served as consulting architect on the main bridge. The main bridge superstructure was fabricated and erected by the American Bridge Co., the Ontario approach superstructure by the Sarnia Bridge Co., and the American approach superstructure by the Wisconsin Bridge & Iron Co. The Missouri Valley Bridge & Iron Co. and the Kansas City Bridge Co. were joint contractors on the main bridge substructure.

General direction of the work was under V. B. Steinbaugh, deputy commissioner and chief engineer of the Michigan highway department, and chairman of the Michigan State Bridge Commission; Murray D. Van Wagoner, Michigan state highway commissioner; T. B. McQuestion, minister of highways in Ontario and R. M. Smith, deputy minister of highways in Ontario.

The main bridge was financed through the sale of revenue bonds by the Michigan State Bridge Commission, a public body. The Canadian approach was constructed and paid for by the Ontario highway department assisted by the Dominion government, and the American approach by the Michigan state highway department with assistance of the U. S. Bureau of Public Roads.

Balanced Cantilver Erection Of Twin Tied Arches

LYNDON F. KIRKLEY

Fabricated Steel Construction Division, Bethlehem Steel Co., Bethlehem, Pa.

Middletown Bridge in Connecticut built with minimum of falsework by resort to cable tiebacks.

With the opening, Aug. 6, of the bridge over the Connecticut River between Middletown and Portland, Conn., an old dream of the residents of the two towns was brought to realization. Consisting of two 600-ft. three-hinged tied arches and plate girder approaches, the bridge has a total length of 3420 ft. Under construction since May 1, 1936, it is the largest bridge in the state and the only highway crossing of the river between Hartford, 15 miles upstream, and East Haddem, 13 miles below. In its construction, the erection of the two arch spans that cross the river was the most difficult part of the job and of main interest because of the method used, which involved building two half-spans as cantilever arms balanced by temporary cable tiebacks between the top chords of the trusses over the pier in the center of the river. This method was adopted because it required a minimum of falsework and eliminated it entirely in the west three-quarters of span B into which the swing span of the adjacent old bridge (Fig. 3) had to move when opened to pass boats. Also this method proved to be more economical than others considered, since the required amount of cable was available at a reasonable rental price. The five falsework bents required (three made and two re-used) could be built-up of floor beam material from the Portland approach and therefore did not present a material expense.

The principal dimensions of the arch spans are given in Fig. 2. Between the two main trusses, 50 ft. apart, is a 45-ft. roadway consisting of a $3\frac{1}{2}$-in. steel grid floor filled with fine-aggregate concrete. Two 6-ft. sidewalks are cantilevered outside the trusses. An underclearance of 93 ft. above mean low water is provided, compared to 23 ft. on the adjacent old bridge, which will be removed. Silicon steel is used in all truss members, and carbon steel for the floor system, the sway frames and the lateral system, which occurs only in the plane of the top chord of the trusses.

The Middletown approach, 990 ft. long, on a 4.45 per cent maximum grade, is composed of seven simple girder spans varying from 87 to 110 ft. and two 175-ft. spans in a continuous girder layout that was adopted because of economy; also simple spans of 175 ft. would have required deep girders that would have interrupted the uniformity of girder depth (8 ft. $4\frac{1}{2}$ in.) that was desired throughout the approach. The Portland approach, 1220 ft. long, is of typical viaduct design using 35-ft. braced tower spans alternating with single span girders from 70 to 110 ft. long. There are 8 tower spans and 11 girder spans. The maximum grade is 2 per cent. The girders on both approaches, which are mainly of silicon steel, 45 ft. c. to c., support a four-lane 45-ft. concrete slab roadway 8 in. thick. A 6-ft. sidewalk is cantilevered on the outside of each girder. Both approaches were erected by a deck traveler which, upon reaching the main arch piers, set the first false-work bent, erected the first two panels of arch steel and then assembled a traveler on the top chord, thus setting the stage for arch erection.

The erection plan

Erection procedure on the twin tied arches is diagrammed in Fig. 2. The half of arch A from pier 9 eastward and the half of arch B from pier 11 west were erected by ordinary cantilever methods over two falsework bents. Procedure on the two halves was identical. Erection of the west half of span A was completed first. Then the two inner halves, balanced about pier 10, were erected.

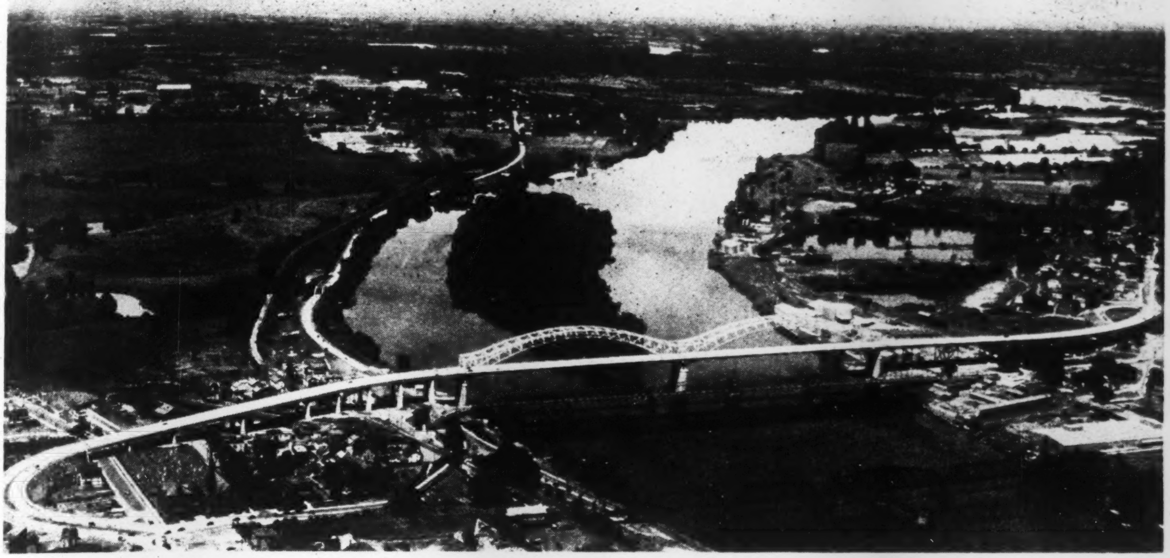


Fig. 1. **High above the adjacent old bridge, the twin arches of the new Middletown Bridge are out of reach of Connecticut River floods. The curved approach at the left comes to a grade on high ground on the main street of Middletown. Largest bridge in Connecticut, the cost was about $3,500,000.**

and span A closed and the floor system hung. The east half of span B was the last completed. The tie eyebars and the floor hanger cables in each span were erected with the arch steel, but no floor system steel was suspended until the eyebars were joined at the center of each span, and the arches swung free of temporary supports. Only two arch travelers were used at one time.

While the first half arch was progressing out from pier 9, a guy derrick with 90-ft. mast and 80-ft. boom, set up on pier 10, erected falsework bent III, two panels west of the pier, and then by a series of steps erected the first two panels of each arch. No falsework bent comparable to bent III could be used in span B, since it would foul the opening of the old

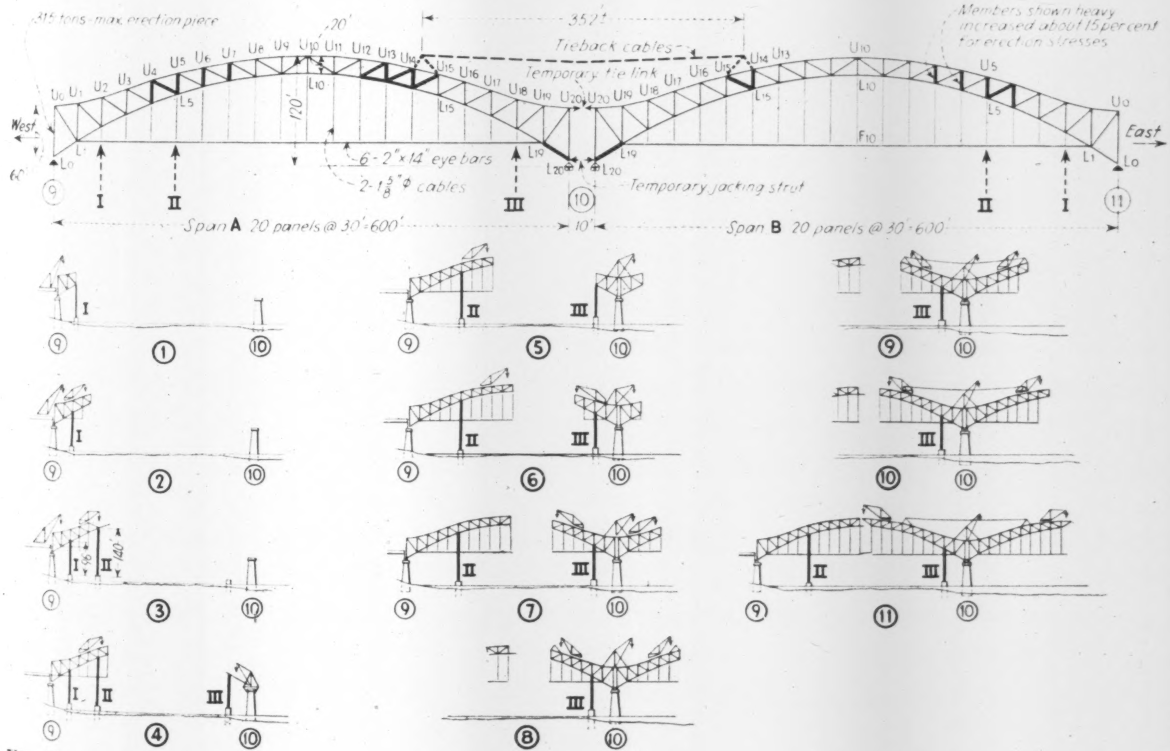

315 tons-max. erection piece
20'
352'±
Tieback cables
Temporary tie link
Members shown heavy increased about 15 percent for erection stresses
U0 U1 U2 U3 U4 U5 U6 U7 U8 U9 U10 U11 U12 U13 U14 U15 U16 U17 U18 U19 U20
L0 L1 L5 L10 L15 L19 L20
F10
120'
60'
West
East
6-2"x14" eye bars
2-1 5/8" ϕ cables
Temporary jacking strut
9
10
11
I
II
III
Span A 20 panels @ 30'=600'
10'
Span B 20 panels @ 30'=600'
①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑪
76'
140'

Fig. 2. **Steps in the erection procedure used on the new Connecticut River crossing between Middletown and Portland, Conn.**

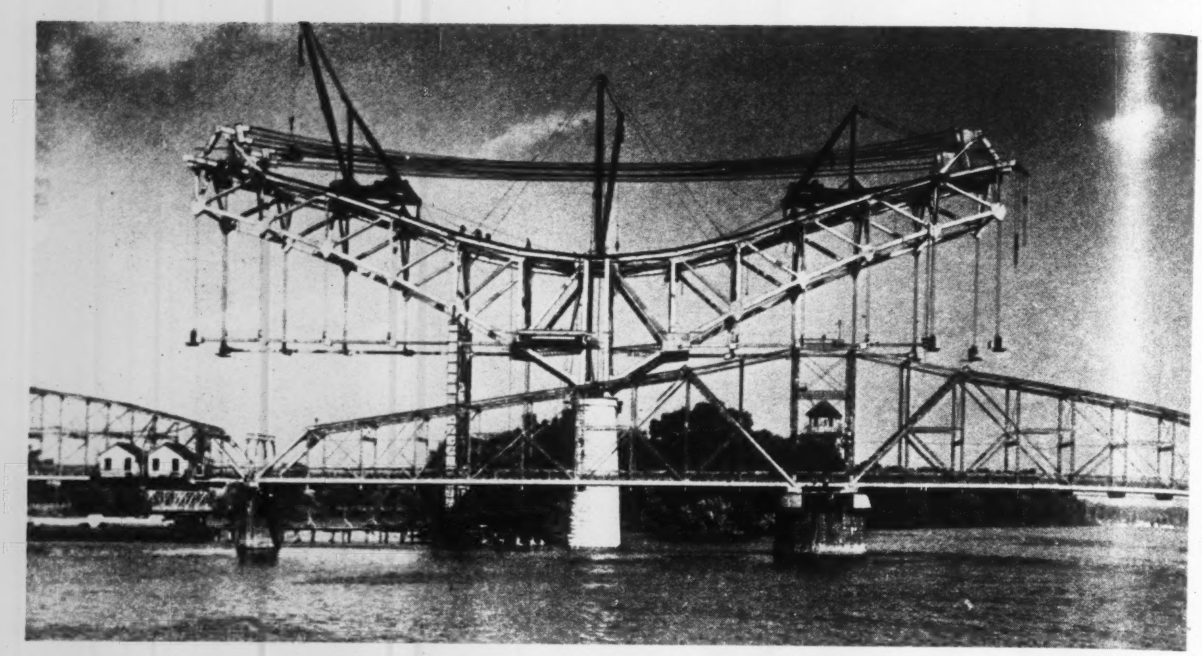


Fig. 3. Balanced cantilever erection of twin 600-ft. tied arches about a center pier with the aid of a cable tieback system. The old bridge that is to be removed is in the foreground.

swing span, and therefore the west half of span B had to be supported at all times from the east half of span A. Accordingly, two temporary silicon steel links of fixed length, each 26x2 in. in gross section, were pin connected between the U_{20} points of both trusses, and adjustable jacking struts, with two 350-ton hydraulic jacks each, were placed between the L_{20} points. These details not only supported span B from span A but also provided means for raising or lowering the arch halves by jacking; with one roller shoe "killed" and the other free, horizontal movement in the jacking strut was translated into vertical movement of the trusses by virtue of the fixed length ties at the U_{20} points.

After the guy derrick completed erection of the first two panels of each arch, it was jumped to the top chord level and assembled the two arch travelers which were to proceed simultaneously in opposite directions from the pier. With the traveler on span A at all times slightly ahead of the other traveler in number of pieces in place, in order to maintain a downward load on falsework bent III, the two travelers erected trusses, hangers and eyebars by cantilevering ahead until panel point 14 was reached. At this stage of the work, the special tieback system between the two arches was assembled to take the cantilevered weight of span B and allow erection to proceed to the center of each span without excessive erection stresses in the truss members; only a few members adjacent to the tieback supports were required to be reinforced.

The cable tieback system

The design and erection of the cable tieback system presented a number of problems. Although span A could be closed by lowering falsework bents II and III, the closure of span B depended upon the length of the tiebacks, the deflection of the two half arches from the tieback support and over bent II at the east end and also the upward deflection of the trusses in span A due to the cable tieback pull. The stresses, truss deflections and panel point positions, therefore, had to be predetermined with great accuracy in order that the adjustments available by jacks in the cable supports and in the struts over the center pier would be sufficient. It was particularly important that the actual length of the tieback cables should agree with the calculated length.

In general, the tieback equipment consisted of four A-frames in the plane of the trusses, pin connected to the top chords at U_{14} and U_{15} of each truss on each span and laterally supported on the outside of the trusses. To the apex of each frame were attached members containing 2 sets of 30-in. diameter cast steel sheaves on 9-in. diameter pins. Over these sheaves were reeved four sets (two per truss) of 12 part $1\frac{1}{2}$-in. diameter wire rope falls. The tension leg of each frame (the side away from the cables) was made adjustable with a 500-ton hydraulic jack for tightening and releasing the cable ties. The sheave supports over span B were made stationary (triangular in shape) while those over span A were of a toggle type (Fig. 5) for equalizing stress in the two sets of cables during adjustment.

Reeving and adjusting the cables

Instead of handling and reeving the $1\frac{1}{2}$-in. diameter tieback cables directly over the sheaves, a $\frac{5}{8}$-in. diameter wire rope guide cable was first reeved. One end of this cable was attached to the $1\frac{1}{2}$-in. cable by a special Kellum's grip and the other end to a hoisting engine below the bridge, and the $1\frac{1}{2}$-in. cable pulled over the two sets of sheaves as the guide cable was pulled out. After the twelve parts of each set of cable were reeved, the two ends of the cable were entered through the tieback support on span A and temporarily clamped with an 18-ft. tail overhanging. This gave the cables about an 18-ft. sag at the center.

To bring each cable set from the initial 18-ft. sag to the 6½-ft. sag indicated by the calculations, it was found necessary to pull in the two ends of each cable about 12 ft. By taking up the slack on each end, overhauling of cables over the 30-in. sheaves was minimized. The guy derrick at pier 10 was used to "shake up" the strands of each set that were seriously out of line. This was accomplished either by raising up or pulling down on the strands to cause them to overhaul slightly on the sheaves in the supports.

After this rough adjustment of strands was performed, a pre-measured music guide wire, 0.045 in. in diameter, was stretched between the sheave pins, and the sag of the cable sets compared to that of the guide wire. Small adjustments of a few inches to a foot were made in the cable by taking in or letting out on one or both ends if and as required. An average of two adjustments per cable was required.

Jacking

After the cables were adjusted to the 6½-ft. sag, the next step was to jack at both tieback supports and at the center pier jacking struts to release the tie links at U_{20}. First the jacks in the supports on span B were run up 7 in., which removed an appreciable amount of the cable sag. Then the jacks in the supports on span A were run up 2½ in. Next the jacking struts at L_{20} were released about 7 in. at which time one pin in the U_{20} tie link on each truss began to be free. It was decided, however, to use the full amount of jacking available in the supports on span A, so the jacks were expanded 3 in. more, after which the link pins at U_{20} were easily removed.

The time required to erect the tiebacks, adjust them and swing the two half arches onto the cable system was 14½ working days. The total weight of steel in tieback supports, pins, sheaves, etc., and including 16,320 ft. of 1½-in. cable, was about 150 tons.

Closing the arch spans

After the cable tiebacks were made effective, the two halves of the arches were erected to their respective span centers by ordinary cantilever procedure. Arch A was the first to be

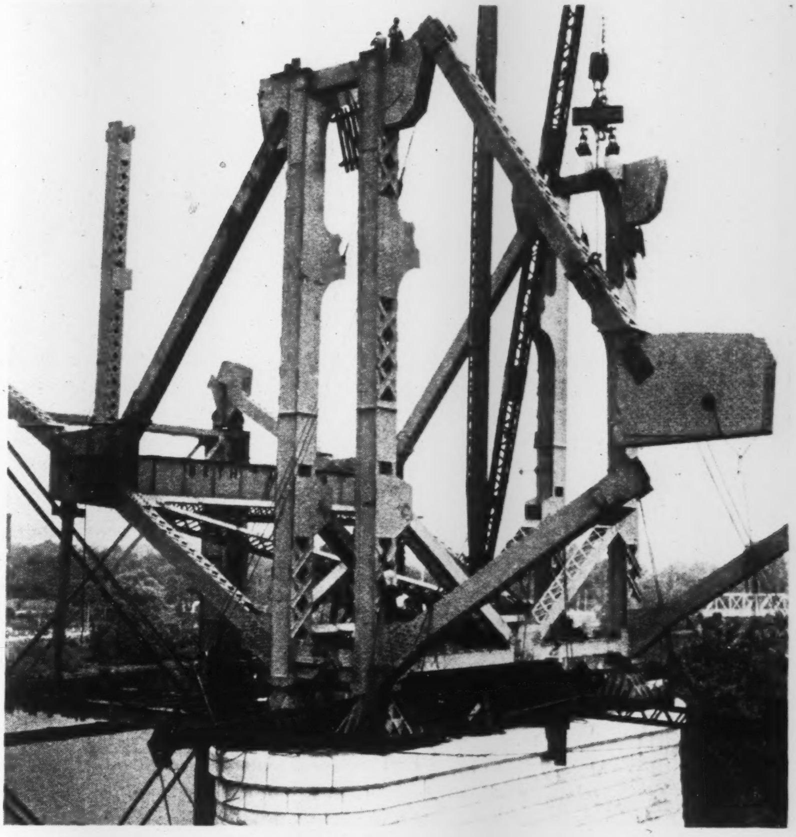


Fig. 4. Start of erection operations on the center pier, using a guy derrick to set up the first two panels of each span. Note the tie bars between the end posts at the top and the jacking struts between them at the bottom.

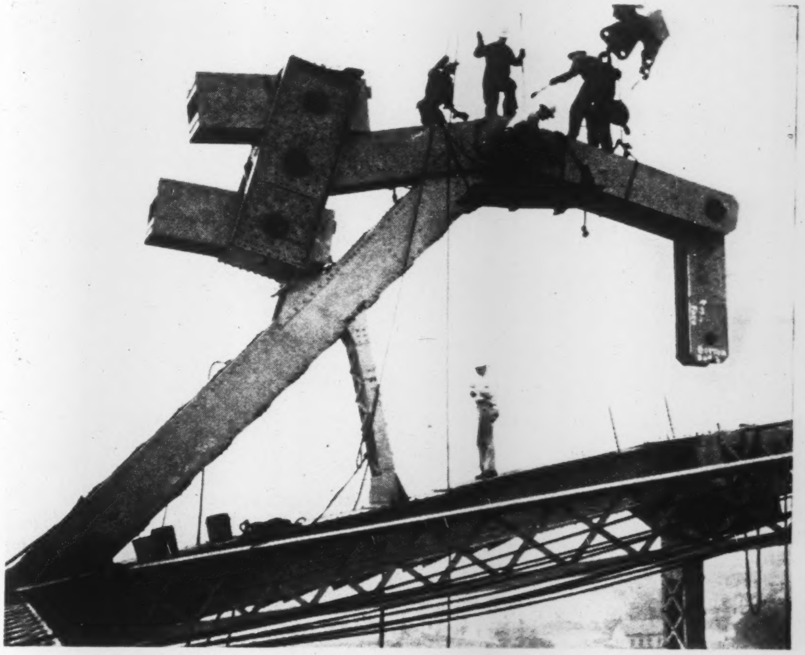


Fig. 5. Erecting an A-frame of the cable tieback system. The member being placed will incorporate a 500-ton hydraulic jack for adjusting the cables.

closed. During the entire period the arch sections were being erected, falsework bents II and III were kept several inches high so that there would be an opening of about $8\frac{1}{2}$ in. at U_{10} when the closing top chord section was erected. To compensate for this raised position of the two halves, tending to separate the closing ends of the bottom chord eyebars, the L_{20} expansion shoes of this span were jacked 10 in. west by means of the jacking struts over pier 10, permitting the pin at F_{10} to be driven. During this operation the expansion shoes of span B on this center pier were held fixed.

After the eyebars were joined, falsework bents II and III were lowered simultaneously until the eyebars became effective and the arch was self-supporting. The jacking strut over pier 10 was also decreased in length as the slack was taken up and the slight elongation developed in the eyebars.

Span B was closed in a similar manner, the eyebar chord being first connected at the center. Then falsework bent II was lowered and the cable tieback lengthened simultaneously until the eyebars became effective, after which the arch was self-supporting.

Finally the two arch travelers on span B backed down the top chords, filling in the floor system of the span from the center toward the piers. The floor system in span A, from which the arch travelers had been removed, was erected by a small deck traveler working eastward from pier 9 toward pier 10.

Contractors and engineers

The Middletown-Portland bridge was built by the Connecticut state highway commission under the direction of E. C. Welden, deputy highway commissioner, L. G. Sumner, engineer of bridges and structures, and W. G. Grove. The substructure contract for all approach piers and the three main river piers was completed by Merritt, Chapman & Scott Corp. at a cost of about $1,000,000. The superstructure, including roadway slab and painting, was built by the fabricated steel construction division of Bethlehem Steel Co., at a contract price of about $1,100,000. The entire bridge project, including property damages and connecting approaches, cost about $3,500,000.

Highway Officials Meet at Reno

Exchange of ideas and adoption of specifications for truck sizes and loads feature gathering of representatives of eleven western states and Texas

THE seventeenth annual meeting of the Western Association of State Highway Officials at Reno, Nevada, August 10 to 13, was attended by about 400 delegates and guests representing eleven western states and Texas. Papers on a highly diversified program ranged from relations with union labor to roadside improvement. A national flavor was given to the program by participation of officers of the American Roadbuilders Association, Associated General Contractors, American Automobile Association and American Association of State Highway Officials. Effective cooperation resulted from the presence of officials of the U. S. Bureau of Public Roads, U. S. Forest Service, and the National Park Service.

L. V. Murrow, director of highways, state highway department, Washington, presided over the sessions in a way to encourage discussion, and very general participation resulted. Topics of special interest were made the subjects of general discussions by calling for expression from each of the member states. The two and a half days of general sessions were supplemented by a 50-mi. motor trip to Cal-Neva Lodge on Lake Tahoe where 425 gathered for the annual banquet.

Union labor diffifficulties

E. P. Palmer, president, Associated General Contractors, outlined problems resulting from the infiltration of union labor organization into highway and public works construction fields. Notable are the craft- and territorial jurisdictional disputes now appearing in the highway field just as they have heretofore in the building trades. An injustice in this is that it operates to prevent the contractor from taking his trained organization from one job to another. Unions are open to criticism, he said, in claiming all the work possible for their craft in the highway field, disregarding present practices in the industry. The lines of demarcation between the various crafts are not clearly established in road construction, and the possibility of jurisdictional disputes are multiplied many times over as compared to some other fields. Contractors want to pay fair wages but there is a limit to unreasonableness of union officials, and labor must learn to take its share of responsibility.

The AGC does not arbitrate such disputes but some of the chapters have successfully negotiated agreements covering entire cities or even on a statewide basis. One conclusion that is sure, he said, is that highway officials, contractors and labor must meet on the common ground of furnishing the taxpayers with the maximum in highway construction for each dollar expended. To that end, at least, there should be a willingness for each to try to see the other's side of the question and to sit down together to work out an acceptable solution of common problems.

The round-table discussion on future roadside improvement brought contributions from nearly every state. The general opinion was that care must be taken to plan roadside improvements that will not involve high maintenance expense.

Some states feature facilities for picnicking, drinking fountains and roadside camps. Texas reported 400 roadside parks, 150 lunch places and 264 historical markers. Texas acquires a 300-ft. right-of-way for important routes.

Emphasis was placed on the greatly improved appearance of roads resulting from rounding off the edges of slopes in cuts. T. C. Carpenter, National Park Service, pointed out that the use of flatter slopes, which greatly improve the appearance of cuts, does not unduly add to the cost; part of the expense is justified by the stabilization that results, and maintenance is almost sure to be lessened.

Coordination of safety practices in the eleven western states and Texas was the title of a paper by Bernard C. Hartung, Nevada highway commission. Mr. Hartung stressed the need for uniformity in regulation and methods pertaining to highway safety. To other western states, Nevada is sending out an 8-page questionnaire relative to inspection, accident reporting, registration and other regulations. The pooling of this information is regarded as an important move toward remedy of the serious lack of standardization that now obtains in licensing of drivers, policing highways, periodic inspection of vehicles, speed limitations, traffic signs, and accident reporting.

California recently centralized accident reports in a safety department which divides all highways of the state into 10-mi. sections to build up a "pattern of accidents." In California the rural highway systems have an annual accident rate of 0.7 per mi. of highway or 1.7 accidents per million vehicle-miles.

Colorado, recognizing that accident records are only as good as are reports thereon, is employing an educational program in accident reporting for patrolmen and all rural peace officers. A film record of accident reports has been made, and some 24,000 such reports are being analyzed by machine tabulation methods. Emphasis was placed on the need for compulsory state inspection of motor vehicles and on the advantage of uniform center striping methods. Double striping, rather than color distinction, was recommended as an aid to color-blind drivers. In addition to the multiple stripes, Nevada uses arrows to indicate limits of permissible crossovers on vertical curves.

Utah has found that 2 to 3 per cent of applicants for drivers licenses fail to pass eye or driving tests. In that state the need for state control of motor vehicle inspection was demonstrated by sending two cars with plain-clothes drivers to a considerable number of the official inspection stations. Although these cars were seriously and dangerously defective in several ways, 20 per cent of the stations took the 50c. inspection fee and issued the "approved" sticker.

In the state of Washington the percentage of accidents involving out-of-state cars varies rather uniformly with, and is about double the percentage of, such cars. For example, near the southern state boundary, where "foreign" cars constitute about 25 per cent of the traffic, 48 per cent of the accidents involve such cars: in central portions of the state where only 8 per cent of the cars are from other states, 18 per cent of the accidents involve such cars.

LIMITS ON TRUCK WEIGHTS AND SIZES

Recommended by Western Association of State Highway Officials

Width: **No vehicle shall exceed a total outside width of 8 ft. except that until Jan. 1, 1945, certain provisions are made for vehicles on which pneumatic tires were substituted for solid tires.**

Height: **Maximum height of vehicle (loaded or unloaded) shall be 13½ ft.**

Length: **Maximum overall length of a single vehicle shall be 35 ft. Combinations of vehicles shall not include more than two units and shall not exceed 60 ft. without special permit.**

Speed: **Maximum speed of trucks shall be 45 mph.; no motor vehicle shall be driven so slowly as to impede or block the reasonable movement of traffic unless such reduced speed is necessary for safety. Vehicles using solid rubber tires shall not exceed 10 mph.**

Axle load: **No pneumatic tire shall carry more than 9,000 lb. nor shall the total load carried by any axle exceed 18,000 lb. Solid rubber tires, or cushion-tire wheels shall be limited to 8,000 lb. per wheel and 16,000 lb. per axle. These limitations apply to rural and inter-city roads but not in metropolitan areas.**

Gross weights: **No vehicle, or combination of vehicles, shall operate with gross weight exceeding that given by the formula $W = 750\ (L + 40)$, where W = total gross weight in pounds and L = distance in feet between first and last axles of vehicle or combination. Where the value L is not more than 18 ft., the co-efficient shall be reduced from 750 to 650.**

Load per in. of tire width: **No wheel, pneumatic or solid rubber, shall carry a load in excess of 600 lb. for each inch of tire width.**

Washington recently began compulsory, state-operated inspection for motor vehicles. This is made without charge but the cost (actually about 50c .per car) is met by funds accumulate by charging $2 for a driver's license. For less thickly settled parts of the state inspection of vehicles is conducted with portable units which move from place to place. Twelve such units are now in use. Ultimately two inspections per year are planned.

From compulsory inspection carried on in the city of Seattle for a period of about two years it is believed that in the first year about 65 per cent of the vehicles inspected will be found to have more or less serious defects, but that in the second year familiarity with the requirements will reduce the percentage to about 30. Because a car found defective must carry a red sticker until indicated repairs are made, the result has been a prompt endeavor by the owner to get the necessary work done so that the red sticker can be removed.

Kenneth Godwin, regional engineer PWA, stated that under present rules a very large amount of road construction in western states can be done immediately with PWA funds provided the work can be started without delay. For example, in four western states $13,500,000 in PWA funds has been spent in the past 4½ years, he said, and under the new allotment California alone will have available $15,000,000, provided immediate action can be obtained. To be effective, however, applications must be in before September 30; if elections are prerequisite they must be held before October 1, and all construction approved must be started before the first of next year.

Right-of-way practice

In a general discussion on the best method of handling right-of-way problems, California reported that, assuming that the state has prior and superior right to land needed for roads, utilities must bear the cost of moving poles, pipe lines, etc., wherever this is made necessary by road construction. In California the highway commission builds right-of-way fences, except on range land, but requires that the owner maintain them. Colorado finds it necessary to fence practically all right-of-way, including range land, because of accident risk from stock on the roads. In Oregon, agreements are made with railroads about cost of relocation, but with other utilities the state bears the cost of removals incidental to road construction.

Utah pays a "fair price" for moving utilities and finds that roadside appearance is better when the highway commission builds right-of-way fences than when owners do this work. However, if the state maintains the fence (as required by the U. S. Bureau of Public Roads) question arises whether the state has not assumed legal responsibility when stock gets out and causes highway accidents.

Charles Upham, engineer-director, American Road Builders Association, spoke on the subject, "Streamline Traffic Demands Challenge the Highway Department," but left the scheduled theme to stress "the greatest problem now before the roadbuilding industry—highway finance." With the old 7 per cent system replaced by the present program in which federal funds are available up to 45 per cent of construction costs, a large part of future work now being planned depends upon the union of the several states in working for needed federal authorization of road funds. Even when authorization has been secured there is still danger because "cancellation" has been suggested and even now "the highway program, so far as federal appropriations are concerned, is suspended on a very fine thread."

Mr. Upham mentioned the possibility of holding a road show and exhibit at San Francisco next year in February or March. He said the manufacturers are not yet committed to the plan and are hesitant as to whether it should be carried out. Cooperation of the western states is needed if this plan is to be consummated.

Uniform specifications

A report of the committee on "uniform axle loading widths, lengths and heights for trucks" was presented by George T. McCoy, assistant state highway engineer, California. Leading up to the recommendations in this report, it was pointed out that existing laws do not take account of existing bridge requirements as distinct from standards used in building new and modern bridges. About 10 per cent of the total number of bridges on California roads have been posted for limited loads (by reason of out-of-date structures on county road systems), and these restrictions put limitations on many miles of adjoining highways. The recommendations in the report were unanimously adopted by the convention and included the essential provisions presented in the panel on the preceding page.

At the opening session L. I. Hewes, deputy chief engineer, U. S. Bureau of Public Roads, presented a comprehensive report on progress in highway development, emphasizing the current inventory program.

Chlorination Controls Bulking Sludge

Experiences at Illinois activated sludge plant show effectiveness of chlorine gas application

CHLORINE has been used successfully in some cases for control of acute bulking of activated sludge by filamentous growths, and its use on raw sewage for this purpose at Flora, Ill., is cited by L. D. Hudson, district engineer of the state department of public health. In this case, extremely concentrated and septic sewage combined with wastes from a milk-products plant, resulted in severe bulking due to filamentous growths. Unless the primary settling tank could be reconditioned, and the fungus growth controlled, it was considered useless to chlorinate the return sludge.

A shock dose of 10 p.p.m. of chlorine in the form of calcium hypochlorite was added to the primary tank on Aug. 13, last year. As no beneficial results were shown next day, chlorination of raw sewage was started, with a dosage of 5 p.p.m. On Aug. 15, the growth in the tank was coming under control and the solids began to settle. Tank effluent remained good. Bulking of sludge in the final tank continued spasmodically, but was less severe. The use of calcium hypochlorite being expensive, a drum of chlorine gas was secured. All objectionable odors in the raw sewage were abated by the chlorine. For the next two days the condition of the primary tank improved and bulking in the final tank occurred only during periods of extremely heavy flow. Chlorination was then stopped.

Within one day, bulking occurred in the primary tank, and the floc in the final tank did not settle, but when chlorination was resumed on Aug. 20 conditions again improved. Slight bulking occurred in the final tank after peak flow periods of the day, and the floc did not rise on cloudy days. To maintain a good effluent, the superintendent, Mr. Coil, had one aerator pumped dry during the evening, so that it would be filled during the peak flow time. In this way the upward currents in the final tank were reduced and floc particles did not rise to the surface. The chlorination was continued until Aug. 29, the appearance of the primary tank being then normal, with bulking apparently controlled. A few hair-like filaments showed in the activated sludge.

But on Aug. 30 the primary tank began to show rising sludge and bulking upset the operation of the final settling tank. Chlorination of the raw sewage was again started, using a dosage of 5 p.p.m. Sludge rising in the primary tank then ceased on Sept. 3, but the activated sludge would not settle in the final tank. However, cool weather and rain then set in, and the plant recovered its normal operation.

On the basis of these experiences the following conclusions were presented: (1) Severe bulking of sludge in the primary tank due to the presence of thin branch-like filamentous growth was controlled successfully by chlorination of the raw sewage; (2) Recovery would probably have been quicker with chlorine applied to the return sludge as well as the raw sewage; (3) Most of the objectionable sewage odors were controlled by the chlorination; (4) Cost of chlorination during periods when sludge bulking occurs is offset in part by the reduction in power demand.

BOOK NOTES AND REVIEWS

The month's additions to the engineer's reading and reference list

Burnham to Empire State

CHANGING THE SKYLINE—By Paul Starrett. 319 pp. Published by McGraw-Hill Book Co., Inc., New York and London. Price $3.

From draftsman in Daniel L. Burnham's office to builder of the Empire State Building, that is the life and story of Paul Starrett. His autobiography tells the story in vivid style, and with it contributes an important and fascinating document to contemporary history.

Just fifty years ago Starrett entered the office of the man who soon after was to be the creator of the World's Columbian Exposition and father of the Chicago Plan. Burnham inspired young Starrett greatly, as did in lesser degree John W. Root, Burnham's partner. He learned architecture from them, structural engineering from E. C. Shankland—who was employed by the firm as engineer after a building collapse that taught the need for care in steel construction—and building procedure from his own observation.

The late 80s and early 90s were a time of great beginnings. The skyscraper had just been born—in Buffington's dreams, Jenney's Home Insurance Building, and Holabird & Roche's Tacoma Building. George A. Fuller was marking out new paths in building construction. The Exposition project was launched, and with it many sensational performances in architecture and engineering were initiated. The great panic of 1893 cast a temporary pall over all development, but when it was over a surge of new growth set in all over the country which carried the large cities forward into a marvelous building era, not ended until 35 years later. Paul Starrett was an integral part of that era; he helped to shape it, and in the Empire State Building he set a memorial to its close.

The ghosts of Elliot M. Statler, Harry S. Black, James Stillman, Samuel Rea, Henry C. Frick, Frank Munsey, Cass Gilbert, Stanford White, Admiral Bowles and Charles Piez of wartime shipbuilding note, Sam Parks, George C. Boldt and others stalk through the pages, not to mention such more substantial figures as Alfred E. Smith, Frederick H. Ecker and Charles M. Schwab. With the true courage of the historian the author does not hesitate to tear down reputations, whether of gypping architect or of gambling contractor and unscrupulous financier. But he also builds up other reputations.

The beginning and the end, Burnham and the Empire State Building, are brought together in the closing passage of the book:

"The Mayor of New York has been heard to remark that fifty years would pass before another skyscraper would be raised higher than the Empire State Building. In some ways I want to believe that. Yet to my mind again come the words of Burnham: 'Remember that our sons and grandsons are going to do things that would stagger us'."

This note of hope aptly summarizes and concludes a book that is well worth reading.

Early Engineering

MASTER BUILDERS OF SIXTY CENTURIES—By John A. Miller. 315 pp. Published by D. Appleton-Century Co., New York and London. Price $3.

Engineers will find much of interest in this quick survey of the great engineering undertakings of which there is any record. The book begins with the monumental pyramids of Egypt and continues through the completion of the Panama Canal. It does not attempt to cover all the large engineering works of modern times. The author, himself an engineer, has viewed the records of early engineering work with an engineer's eye and yet has set down his findings in language that is equally understandable by the layman.

The subjects are treated in chronological order, which is helpful in aiding the reader to get a better understanding of the time relation between such works as the Great Wall of China and the Roman road system. Special attention is given to methods of construction. Though each undertaking is treated separately, thus aiding those looking for information on any one subject, a certain amount of continuity is provided by comment on how improved types of construction developed as time went on. Though written for popular consumption rather than as an engineering text, this book will prove to be a welcome addition to the libraries of engineers.

Housing

HOUSING COMES OF AGE—By Michael W. Straus and Talbot Wegg. 259 pp. Published by the Oxford University Press, New York. Price $2.75.

URBAN BLIGHT AND SLUMS—By Mabel L. Walker. 442 pp. Published by the Harvard University Press, Cambridge, Mass. Price $4.

Both of these books furnish important additions to housing knowledge, "Urban Blight and Slums" being scholarly, fundamental and broad in scope, while "Housing Comes of Age" is reportorial in nature and confined to publicly-owned housing. The latter describes one possible and partial solution of the broad problem considered by the former; it is the life history of the PWA housing effort, now grown to a permanent organization and plan in the United States Housing Authority. Mr. Straus, who was director of information, and Mr. Wegg, one of the architects of the PWA Housing Division, write from personal knowledge, and produce an informing story.

As one of the Harvard City Planning Series, Mabel L. Walker's book is an objective study of a current problem. As Dr. Walker is a specialist on tax questions, the book naturally lays emphasis on the role that taxes play in land values. In this respect alone the book commands high regard, for few persons have had either the courage or knowledge to analyze the close connection between fictitious land values and the persistence of slums. But many other phases of the subject are covered also, both by Dr. Walker and by collaborators. Broadly, these concern planning, deflation of fictitious property values, land assemblies, relation of taxation to blight, financing and construction problems. The book presents a mass of factual data and informed opinions that should aid in putting the slum and housing problem in proper perspective.

Soil Study for Roads

SOIL MECHANICS APPLIED TO HIGHWAY ENGINEERING IN OHIO—By K. B. Woods and R. R. Litehiser. 66 pp. Bulletin No. 99, Engineering Experiment Station, Ohio State University, Columbus, Ohio. Price 50c.

Few states have advanced farther than has Ohio in the application of soil mechanics to roadbuilding. Perhaps no state began earlier its study of road soils, and those who dabbled in the study of soil physics before the recent surge of interest in stabilized soil roads will recall the reports since 1924 of Prof. F. H. Eno from the soils laboratory established jointly by Ohio State University, the Bureau of Public Roads and the Ohio State Highway Department. The present report is not a history but a practical statement of present practice of field and laboratory soils investigations and the use made of such investigations in the design, construction and maintenance of highways in Ohio. It may be read profitably by every state highway department soils engineer.

The Master Plan

THE MASTER PLAN—By Edward M. Bassett. 151 pages. Published by the Russell Sage Foundation, New York. Price, $2.

The master plan of a community is a reference map or guide, rather general in character, which is developed and used by planning commissions as a means to denote their ideas in regard to improvements. What it should and should not contain, and how it differs from the official city map, are the principal matters discussed by Mr. Bassett. Before so doing, however, the author outlines the theory of community land planning legislation, and the seven elements—streets, parks, sites for public buildings, public reservations, zoning districts, utility routes, pier heads and bulkhead lines—for which planning legislation is enacted. In Part II of the book, dealing with the general features of the master plan, there are several chapters summarizing the concept of a master plan as drafted in various state and city planning acts. This is an easily read book which will be instructive alike to the public works official and city planners. It contains the type of information that both need.

NEW PUBLICATIONS

REPORT OF THE BUILDING RESEARCH BOARD FOR THE YEAR 1937—Prepared by the Department of Scientific and Industrial Research, London. 172 pp. Obtainable from the British Libarary of Information, 270 Madison Avenue, New York. Price $1.10.

TRAFFIC PLANNING REPORTS — Toledo, Ohio, 1937 and Louisville, Ky., 1937-38—143 and 142 pp., respectively. Published by Jensen, Bowan & Farrell, Engineers, Ann Arbor, Michigan.

CHANNEL WAVES SUBJECT CHIEFLY TO MOMENTUM CONTROL—Robert E. Horton. 51 pp. Published by Division of Research, Soil Conservation Service, Washington, D. C.

TRAFFIC SURVEY DATA ON THE CITY OF ST. LOUIS, 1936-1937.—Prepared by Charles H. Diel. 60 pp. Published by the Works Progress Administration, St. Louis, Mo.

EFFECT OF CITY WATER AND SEWERAGE FACILITIES ON INDUSTRIAL MARKETS—Market Research Series No. 17—By O. C. Holleran. 100 pp. Published by the Bureau of Foreign and Domestic Commerce, Washington, D. C. Price 10c.

STANDARD PLUMBING—By Louis J. DAY. 119 pp. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, London. Price $6.00.

OFFICIAL MAP PUBLICATIONS — By Walter Thiele, under the direction of A. F. Kuhlman. 356 pp. Published by the American Library Association, Chicago. Price $4.75.

THE FUTURE OF STATE PLANNING—Prepared by the National Resources Committee; a report to the Advisory Committee by the State Planning Review Group, March, 1938. 117 pp. For sale by the Superintendent of Documents, Washington, D. C. Price 25c. (paper cover).

REGIONAL PLANNING, Part VI—UPPER RIO GRANDE, Vol. I Text, Vol. II, Maps—Prepared by the National Resources Committee. 566 pp. For sale by the Superintendent of Documents, Washington, D. C. Price $3.50.

ENGINEERING MECHANICS—By Seibert Fairman and Chester S. Cutshall. 267 pp. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, London. Price $2.75.

WELDING HANDBOOK—1938 Edition—1,211 pp. Published by the American Welding Society, 33 W. 39th St., New York. Price $5 to members; $6 to nonmembers in U.S.A., $6.50 elsewhere.

CONCRETE MANUAL—First Edition. 454 pp. Published by the U. S. Bureau of Reclamation, Customhouse, Denver, Colo. Price $1; $1.12 outside of North America.

REPUBLIC ALLOY STEELS—255 pp. Prepared and published by Republic Steel Corp., Cleveland, Ohio. Limited distribution.

ROAD TRAFFIC AND ITS CONTROL. Volume 7, The Roadmakers Library—By H. Alker Tripp. 414 pp. Published by Edward Arnold & Co., London, and Longmans Green & Co., New York. Price $10.

ESTIMATES AND COSTS OF CONSTRUCTION — By Frank Whitworth Stubbs, Jr. 234 pp. Published by John Wiley & Sons, Inc., New York and Chapman & Hall, Ltd., London. Price $3.

THE RAILWAY AGE—By Cyril Bruyn Andrews. 145 pp. Published by Country Life, Ltd., London and the Macmillan Co., New York. Price $3.

WELT-STRASSENWESEN 1938—272 pp. Published by Otto Elsner, Berlin S. W. 68. Price 15 RM.

ROUTE SURVEYS—By Harry Rubey. 261 pp. Published by The Macmillan Co., New York. Price $3.75.

INDUSTRIAL PRICE POLICIES AND ECONOMIC PROGRESS—By Edwin G. Nourse and Horace B. Drury. 314 pp. Published by the Brookings Institution Washington, D. C. Price $2.50.

ON THE OCCURRENCE CONSERVATION AND UTILIZATION of Water Resources as Related to Physiographic Features with Especial Reference to California—By John V. Zahlen. 177 pp. Published by Almquist & Wiksells Boktryckeri, Uppsala, Sweden. (Limited edition only.)

TAXATION OF GOVERNMENT BONDHOLDERS AND EMPLOYEES—The Immunity Rule and the Sixteenth Amendment—A Study Made by the Department of Justice. 219 pp. For sale by the Superintendent of Documents, Washington, D. C. Price 45c.

STRUCTURAL ALUMINUM — 196 pp. Published by the Aluminum Co. of America, Pittsburgh, Pa. Price $1.25.

FROM FIELD AND OFFICE

Working problems and time-saving methods . . . Edited by Charles S. Hill

True Areas On a Monroe Calculator

Benjamin C. Seal

Senior Draftsman,
Hubbell, Roth & Clark, Inc.,
Detroit, Mich.

The author does not claim to be the inventor of the method outlined as he understands that it has been worked out independently in a few offices. However, it is his belief that a good thing should be passed along.

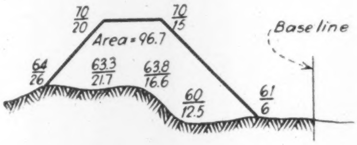
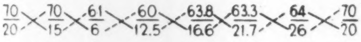


Fig. 1 shows a cross-section area as it might have been plotted from a level book with actual elevations written above the line and distances from the base line below the line. Now write the coordinates going clockwise around the area, connecting the "fractions" criss-cross with



solid and dotted lines as in Fig. 2. Note that the first "fraction" written is repeated at the last. Next multiply 70 times 20 and the answer will come up on the lower dial; clear the upper dial only and multiply 61 times 15, again clearing only the upper dial. Keep going until all of the numbers connected by dotted lines have been multiplied. Still without clearing the lower dial, shove the lever to minus and multiply 64 times 20 using the minus key instead of the plus key. Repeat this process along the solid lines until 70 times 15 is multiplied in reverse. Take one half of the figure remaining on the lower dial and the true area is had. Some calculating machines do not have the lever but instead the numbers come up red in the upper dial. Be sure to keep the decimal point at the same place on the lower dial. On some cross-sections the process will have to be reversed plus multiplying along the solid lines. The machine will let one know when this has to be done as about ten bells will ring and the dial will show all nines. When one becomes familiar with this method he will never use another.

Bending Knee Reinforcing

W. C. Goodwin

Engineer, Truscon Steel Co., Boston, Mass.

Ten Dollar Prize Winner, August

On plans for rigid frame bridges it is not unusual to find a detail at the joint between the vertical leg and the deck as shown in the sketch, where the angles Z_1 and Z_2 are unequal. When scheduling the reinforcing bar that is bent around the knee, the problem is to find the points of curvature and the radius of a circular curve that will join the two tangents and be held a certain specified clearance from the outer surface of the concrete.

It is possible to solve this problem by a curve with the P. C. C. anywhere on the line parallel to BC and the clearance distance inside of it, which means that

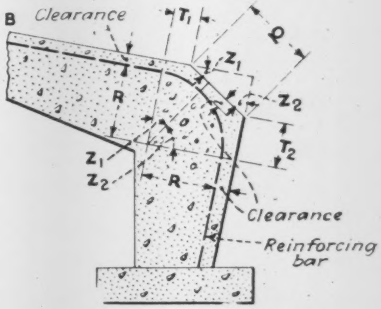
$$Q = T_1 + T_2 \qquad (1)$$

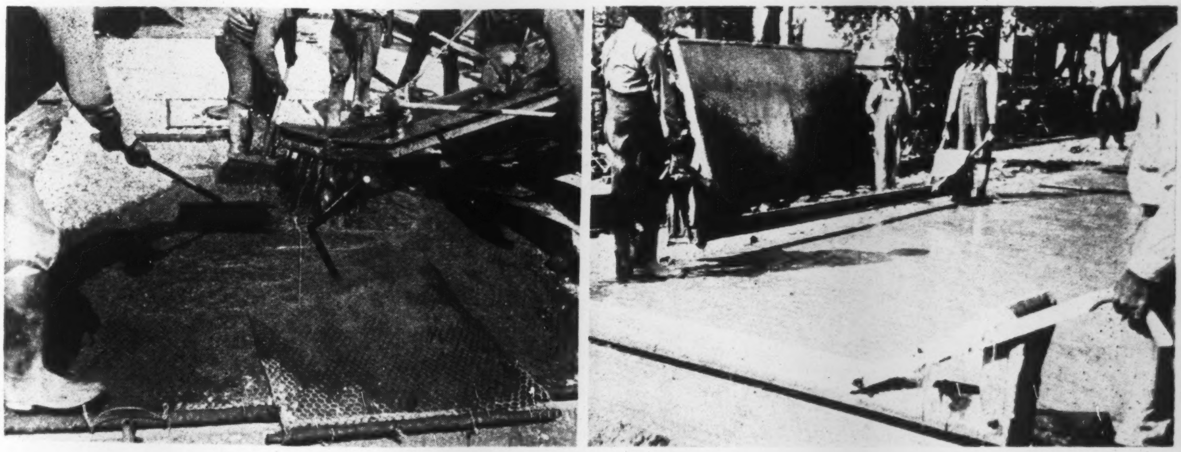
and R + (Clearance) =

$$\frac{T_1}{\tan 1/2\,Z_1} = \frac{T_2}{\tan 1/2\,Z_2} \qquad (2)$$

From these relations it follows that

$$T_1 = Q - T_2 \text{ and } T_2 = \frac{Q}{\dfrac{\tan 1/2\,Z_1}{\tan 1/2\,Z_2} + 1} \qquad (3)$$





CAMERA MEMORANDA

In resurfacing a Chicago street with cement-bound macadam chicken wire was spread over the loose aggregate (left) to prevent it from being dislodged when the grout was broomed into the voids. In tamping the wet grouted aggregate a portable screen (right) kept grout spatter off the sidewalk or adjacent work.

$$R = \frac{T_2}{\tan 1/2\, Z_2} - \text{(Clearance)} \qquad (4)$$

Equation (3) establishes the points of curvature and (4) will give the radius of the required curve. The length of the curve will be

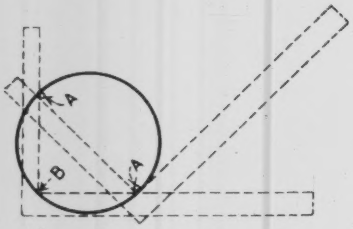
$$2\pi R \frac{Z_1 + Z_2}{360}$$

• • •

To Draw 14-in. Circles

Daniel Griffith
Pittsburgh, Pa.

A convenient way to draw circles 14 in. or less in diameter is shown by the accompanying sketch. The nails A are driven with the outside edges at the required diameter. A mechanic's steel square is then placed with its inside edges against the nails and with a pencil in the angle B, the square is rotated, with the pencil marking out a perfect semicircle. The process is repeated on the other side, giving the full circle.

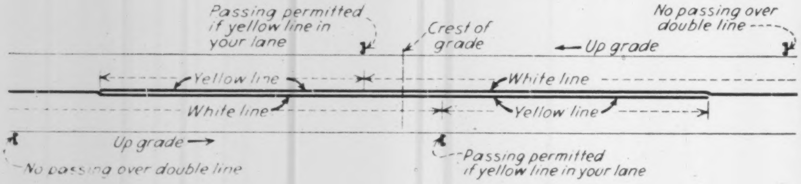


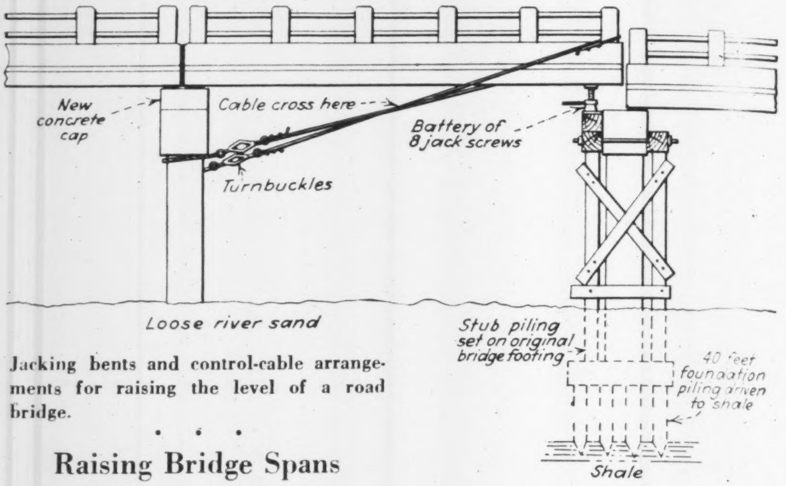
How to draw circles with a carpenter's square

• • •

Two-Color Traffic Line for Hills

A double traffic line on hills means *no crossing* in California practice. Often when a vehicle climbs to the hillcrest and the road down the hill is clear this no-crossing rule unnecessarily lengthens the travel before passing is legal. To avoid this delay the California highway department is marking the pavement and putting signs on hills as shown by the accompanying diagram redrawn from the official journal of the California Division of Highways for June 1938.


Passing permitted if yellow line in your lane
Crest of grade
No passing over double line
← Up grade
Yellow line
White line
White line
Yellow line
Up grade →
No passing over double line
Passing permitted if yellow line in your lane


New concrete cap
Cable cross here
Battery of 8 jack screws
Turnbuckles
Loose river sand
Stub piling set on original bridge footing
40 feet foundation piling driven to shale
Shale

Jacking bents and control-cable arrangements for raising the level of a road bridge.

• • •

Raising Bridge Spans

Richard H. Wood
Assistant Engineer,
Kansas Highway Department,
Cottonwood Falls, Kan.

Three 40-ton concrete deck spans were jacked up and the pier tops built up as shown by the accompanying sketch in raising the level of a Kansas road bridge. As the loose sandy bottom offered no good bearing the timber bents for jacking were set on stub piles driven to the pier footing. A bent was set up on each side of the pier and the two bents were braced and tie-bolted together across the ends of the pier. The raising was done by screw jacks and trouble was experienced with the spans drifting out of line while being raised the necessary 3 ft. This movement was arrested and the spans kept in line by guy cables with turnbuckles arranged as shown.

• • •

Computing Concentric Arcs

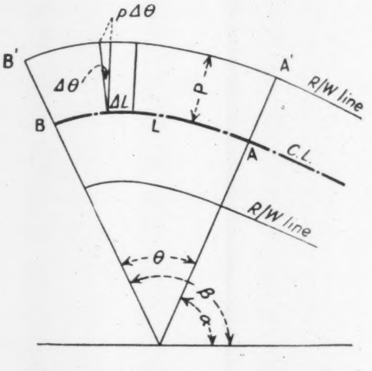
Ernest W. Barrett
Portland, Ore.

For right of way descriptions and other purposes it is often necessary to calculate the length of railroad or highway spirals and circular curves on the right of way line. With a given length of curve on center line, the following method shows how the length of a concentric curve may be found by the addition (if on the outside), or by the subtraction (if on the inside), of a quantity to the center line length.

With reference to the accompanying diagram let L = length of arc on center line and P = distance between arcs. Then Arc A'B'

$$= \lim_{n \to \infty} \sum_{\alpha}^{\beta} (\Delta L + p\Delta\Theta)$$

$$= \int_{\alpha}^{\beta} (dL + p\,d\Theta) = L + p\Theta.$$


pΔθ
B'
A'
Δθ'
ΔL
p
R/W line
B
L
A
C.L.
R/W line
θ
β
α

That is, the difference in length of two concentric arcs is pΘ, or, is equal to the distance between arcs times the central angle expressed in radian measure. With Θ in degrees, this becomes pΘ°/57° .2958.

Example: Given: L = 200 feet on center line; Θ = 10° deg., and p = 50 ft. find length of spiral on a line 50 ft. distant from the center line. The difference in length equals 50 ft. x 10 deg./57 deg. 2958 = 8.73 ft., the length on the outside line equals 200 ft. + 8.73 ft. =208.73 ft. and the length on the inside line equals 200 ft. — 8.73 ft. = 191.27 ft.

The method is the same for concentric circles.